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**ENGINEERING CONTRACTS  
AND SPECIFICATIONS**





# ENGINEERING CONTRACTS AND SPECIFICATIONS

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Knappen Tippetts Abbett Engineering Company

SECOND EDITION

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## PREFACE TO THE SECOND EDITION

The first edition of this book was written during the war and was designed to meet the requirements of the large volume of construction work in progress at that time, much of which was executed by the government. In the second edition, increased emphasis is placed upon contract procedure for private work, although the original material on government methods has been retained and brought up to date. The adoption of the first edition as a textbook for college classes was greater than expected, and the second edition has been written with the view to increasing its usefulness for this purpose.

In general, the entire text has been expanded and largely rewritten within the scope of the first edition. The material on competitive-bid contracts has been combined in Chapter 5 in lieu of the original two chapters in order to obtain a more unified treatment of this subject. An entirely new chapter on construction insurance has been added, and the sections on prequalification and arbitration have been rewritten and expanded. The original chapter on specification writing has been expanded into three new chapters.

ROBERT W. ABBETT

*June, 1948*



## PREFACE TO THE FIRST EDITION

The purpose of this book is to present some of the legal and business aspects of the engineering profession in compact form suitable for reference and textbook use. The scope of the book was determined by a course in contracts and specifications, which I taught in the School of Engineering, Columbia University, and the text was mimeographed for use by students in war training classes in George Washington University during 1943 and 1944. However, much of the material was derived from experience in the management of a large volume of construction work both before and during the present war. I hope that the book may be useful to practicing engineers, architects, and contractors as well as to college students.

An effort has been made to develop basic principles and methods throughout. Chapter 2 contains a brief summary of the elements of business law which are most significant in contract relationships. This is intended to give the engineer a general understanding and appreciation of the legal considerations in construction work and should not be considered a substitute for the advice and services of a professional lawyer on legal matters related to specific contracts. Legal principles are stated in general terms without derivation, and it should be understood that there are many variations in the interpretation and application of the law.

Contract procedure is developed along the lines of private practice, but attention is directed to matters in which government procedure differs. Unique features of government contracts are explained in detail where they occur in the logical development of the subject. This is considered desirable in view of present and probable future emphasis on government-sponsored construction projects. Furthermore, textbook material relative to government contract procedure has not been available previously in engineering literature.

Examples of various contract documents for both private and public works have been included, primarily to illustrate the text rather than for reference purposes. However, they have been selected as representing the best current practice and should serve

as a guide in the preparation of similar documents for specific projects. In this connection the reader is warned against using these illustrations or any of their clauses as "standards" without due consideration of their meaning and intent, in the light of the particular conditions of their proposed use. Disputes and litigation have frequently resulted from injudicious use of "standard" documents.

With regard to specification writing, it is recognized that skill in this field depends largely on experience and engineering judgment, for which there are no substitutes. The instructions given herein are intended to provide a basis for the systematic application of such knowledge and to indicate a form for its presentation. In addition, common flaws collected from a large number of actual specifications are cited in the form of precautions to prevent their recurrence.

ROBERT W. ABBETT

*Washington, D. C.*

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# I

## INTRODUCTION

This book deals with the business, professional, and legal relationships between the principal parties involved in the accomplishment of construction work. The parties concerned are the *owner*, for whom the work is to be done; the *engineer*, who, representing the owner, furnishes the professional and technical skill required in the planning, administration, and construction of the project; and the *contractor*, who furnishes the materials, labor, and equipment necessary for the physical accomplishment of the work. The character of the relationships between these parties is influenced by many factors, depending upon the methods and procedures adopted from the inception to the completion of the work. A clear understanding of the possibilities along these lines is a necessary part of the professional equipment of the engineer because a misstep at any point may void all the precautions and provisions of the design as well as create controversies, excessive costs, and possibly litigation.

**The Construction Industry.** During periods of normal or average business activity, the construction industry is one of the most important, second only to agriculture in the number of workers employed and the volume of capital expended. It produces a large portion of the capital wealth of the country in the form of buildings, highways, railroads, dams, utilities, and similar works. Since the building of these facilities is essentially a manufacturing process, construction should be considered as a manufacturing industry, with all the problems of economics, management, labor, and production which are implied.

Construction differs from other types of manufacturing in one notable respect, however. In the production of most commodities, models and manufacturing methods are more or less standardized to facilitate mass production in a centrally located manufacturing plant, and the finished product is transported to its place of use. The control of the quality and cost of the prod-

uct is greatly simplified by this standardization of methods. In the construction industry, on the other hand, the product is manufactured at its place of use, and an individual plant is necessary for each construction project. Furthermore, each product is individual in character, custom-built according to the desires of the owner. This situation is fundamental to the economics of construction and places important responsibilities on the engineer in connection with the management of construction operations and the control of the quality of the work.

**Public and Private Construction.** Construction work may be performed for a government agency, municipal, county, state, or national, or for a private individual, company, or corporation. All government construction is classed as *public works*. Common types of public works are highways, bridges, sewers, water supplies, land reclamation projects, and public buildings. Private construction includes such work as railroads, buildings, and utilities.

Building construction with the exception of some types of industrial buildings is classed as architectural construction, and the various remaining types of public and private works are known as engineering construction. For simplicity, it is understood in this book that any reference to the owner may mean a private individual, company, corporation, or a government agency. In a similar manner, reference to the engineer may mean either a professional engineer or architect as the case may warrant.

**Economic Necessity; Financing the Project.** The creation of public and private works is not a matter of whim or accident. Basic economic laws are involved. Construction work requires the expenditure of capital. Before a structure can be built a need for it must be evident, and the need must be sufficiently urgent to justify its cost. Furthermore, funds must be available either in the form of capital or credit. These will be furnished by the sponsor of the project, a government agency in the case of public works, and an individual, company, or corporation for private works.

The necessity for a public works project may be self-evident; it may arise by public demand, or it may be determined by expert engineering study in which its merits must be brought to light and made evident to the public. Since the necessity for private work usually can be established only on the basis of a reasonable

return on the investment required to produce it, an estimate of cost and an engineering analysis and forecast of the probable income to be derived are required. A comparison of the cost of the project with the estimated benefits to be obtained by its construction will usually indicate whether the venture is sound from the viewpoint of economics.

Public works are financed by appropriations from annual operating budgets, by special appropriations from taxation receipts, or by special bond issues in which provision is made for the retirement of the bonds by future taxation or by revenue from the use of the structure. Private works are financed by direct expenditure of capital, by loans, or by corporate bond issues in which provision is made for retirement of the bonds by revenue from the completed work. The financing of construction is a matter of promotion as distinguished from the determination of its necessity and type, which are problems in engineering economics.

**Construction by General Contract.** Practically all important public and private works are constructed by firms who specialize in this type of work and who are known as contractors or constructors. The owner and the contractor enter into an agreement whereby the contractor furnishes the required construction services and receives a specified compensation. The contract may be informal or even oral, but, in the opposite extreme, it may be a lengthy formal document. The type of ownership will have an important bearing on the contract form and procedure.

For public works, the method of awarding a contract for construction work is specified by law. The law requires that public advertisements be circulated advising all who may be interested that competitive bids will be received for the work and that the contract will be awarded to the lowest qualified bidder. The legal control of contract letting is designed to prevent fraud and collusion and to insure free and open competition between those interested in performing the work. For private works the procedure may follow the desires or judgment of the owner or the engineer without restriction, although some form of bidding is generally adopted.

Many of the operations necessary for the construction of a comprehensive engineering project require a high degree of specialization for which the general contractor may not be equipped or qualified. He will then enter into a subcontract with a specialty

subcontractor for the accomplishment of such work. In general, specialty subcontract work reflects an economy to the owner because the subcontractor, having mastered the details of his specialty, is usually able to perform such work at a lower cost than can a general contractor whose interests are more diversified. In his relations with the owner the general contractor assumes all obligations of the subcontractor and is in turn held responsible by the owner for the satisfactory completion of the subcontractor's work. As compensation for this responsibility, the general contractor usually includes in his bid price the cost of the subcontract, plus a sufficient amount to cover any of his own expenses in connection with that portion of the work, and a reasonable profit for assuming the responsibility of its administration. The owner and the engineer should maintain close control over subcontract relations to prevent the practice of "contract brokerage," in which a pseudo-contractor may let out all the work to subcontractors, thus obtaining a profit without any effort on his own part. It is expected that usually about 20 to 25 per cent of the work will be accomplished by subcontract and the remainder by the contractor's own forces.

**Construction by Force Account.** As an alternative to the employment of a construction contractor, the owner may elect to do the work with his own forces. This is known as the *force account* or *day labor* method. Under the force account system, the owner maintains direct supervision over the work, furnishes all materials and equipment, and employs workmen under his own payroll or force account. Though most construction work is performed under contract, many important projects have been accomplished by force account. The Panama Canal and some of the Tennessee Valley Authority projects are outstanding examples of public works constructed by this method.

The functions of the engineer on force account work are about the same as for work by contract although some of the formalities may be omitted. The owner must have available a complete construction force, including a competent superintendent. Frequently, however, the engineer may combine his duties with those of the superintendent and serve as the owner's construction manager.

**Construction by Separate Contracts.** Under the general contract method of construction, it is understood that the contractor assumes responsibility for all problems of management,

administration, and coordination of construction operations, including those of subcontractors, whereas under the force account method all these matters are handled by the owner. A third method for accomplishing construction is by separate contracts. Under this method, the owner lets contracts for various portions of the work direct to specialty contractors, thus assuming the managerial functions of the general contractor. When this phase of the work is handled by the engineer, he, in addition to his engineering duties, in effect becomes the owner's agent for the purpose of administering and coordinating the work. By an alternative scheme a general contractor may be retained in a managerial capacity with the definite understanding that all work will be handled by separate contracts which may be on a subcontract basis. This method has many of the advantages of the force account method without the corresponding charges for invested capital. It is not to be confused with "construction brokerage."

**Selection of Construction Method.** When the work to be done is small in scope and simple in character, or when the owner's organization includes a trained and skilled construction force, construction by force account may be advantageous. In this case the owner would be saved the expense of formal contract procedure, and there would be a reduction in construction cost by the elimination of the contractor's profit. Additional saving would come from the reduction in engineering and inspection costs. Inasmuch as the work is done under the direct supervision of the owner, the plans, specifications, and inspection need not be as elaborate or as detailed as those required for contract work.

On the other hand, these advantages may be more apparent than real when compared with contract work under favorable conditions. A qualified contractor is skilled in the administration of construction operations, including the purchasing of materials and the management of labor. He maintains an organization of trained supervisors, mechanics, and workmen and has available the most advanced construction equipment. These specialized production features result in efficiency, and the corresponding reduction in costs usually cannot be matched on force account work, even when the contractor's profit and other apparent advantages of the force account system are taken into consideration. Excepting minor work which can be handled readily by



a maintenance crew, it is the general opinion of the construction industry that in most instances the advantages of work by contract outweigh those for work by force account.

Construction by separate contracts may be advantageous to the owner when the specialty work required is restricted to a relatively few types of construction, when the owner has available a competent construction manager, or when his engineer is experienced along this line. About the only economy possible under this system as compared with general contract work is the saving of the general contractor's profit for managing and coordinating the work of subcontractors. This is not a very important item when compared with the total cost of the work, and unless the owner's manager is thoroughly experienced and competent in contract administration, the possible saving will be more than consumed by the excess costs of inefficient management. In general, an experienced contractor charged with the responsibility for the complete project will be able to perform the work at considerably less cost to the owner than is probable by other methods.

**Plans and Specifications.** Normally, the design of a structure is complete in detail before construction work is begun. In the design all the functional requirements, layout, and dimensions of the project are determined. Also, the type of construction is selected on the basis of suitability, structural stability, cost, appearance, available materials, and construction limitations. The plans and specifications which evolve from these studies define the requirements of the project in detail and show how it is to be constructed.

The drawings consist of plan views, elevations or side views, and cross sections. These are designated general drawings as distinguished from detail drawings which are drawn to a larger scale and show the details of various parts of the structure, how they are assembled, and the types of construction to be used. Usually all these drawings are prepared by the engineer, and, together with the specifications, they are the basis of the contractor's estimate and of the construction contract itself.

The specifications are written instructions which accompany and supplement the plans. Whereas the drawings show the physical characteristics of the structure, the specifications cover the quality of the materials, workmanship, and other technical

requirements. Together with the plans, they form the guide and standard of performance which will be required in the construction of the project. While the plans are technical in nature, the specifications and the contract of which they comprise a part have many legal and business implications in addition to their technical content. Moreover, in the event of a controversy during construction, these documents may be subjected to legal interpretations where the manner in which they are written may result in decisions contrary to their technical intentions. Therefore, it is necessary that the engineer be fully informed in the legal aspects of specification writing.

After the contract is awarded and construction begins, additional drawings become necessary. Shop or working drawings are prepared in connection with the use of prefabricated materials. Whereas the design or contract drawings define the component parts of a structure and how they are assembled to form the whole, shop drawings show how each piece is cut, punched, and connected in the prefabrication process. Structural steel work and various types of carpentry and wood trim assemblies are typical of prefabricated construction requiring shop drawings. Erection drawings, showing how the prefabricated parts are assembled in the field, are necessary for some types of construction, notably structural steel work. All these drawings are normally prepared by the contractor subject to the approval of the engineer. In addition, it may be necessary to show certain features of the work in full-scale drawings or by models for the purpose of making patterns or to demonstrate some intricate part of the structure such as the form of a masonry moulding or cornice. Full-scale drawings or models may be prepared by either the engineer or the contractor, depending on whether the purpose is a matter of design or construction.

**Supervision and Inspection of Construction.** Upon the award of the contract, the engineer assumes control of the work as the authorized representative of the owner. It is the function of the engineer to approve all construction methods and to supervise all operations in behalf of the owner. Close inspection is necessary at all times to make certain that the work is free from defective materials and workmanship and that it meets the requirements of the plans and specifications. Usually the engineer is represented on the job by a resident engineer whose staff main-

tains direct supervision over the details of the work, including the testing and inspection of materials and workmanship. At specified intervals, usually monthly, an estimate is made of work completed, and this forms the basis for progress payments to the contractor in accordance with the terms of the contract. When the work is completed, it is the duty of the engineer to perform a final inspection of the entire project preliminary to its acceptance by the owner and the final payment to the contractor.

One of the most important functions of the engineer during construction is that of interpreting the requirements of the plans and specifications on matters that are questionable or controversial. As an arbiter of disputes within his jurisdiction, his decisions are final and should be rendered with fairness and impartiality to the owner and contractor alike.

It is important to note that although the engineer may have prepared the plans and specifications in the first place, after the contract is signed he is just as rigidly bound by their requirements as the contractor. It is his responsibility to enforce their provisions throughout the work. Any variation from the plans and specifications requires a change in the contract and a corresponding change in the contractor's compensation. These are contractual matters which are usually outside the scope of the engineer's authority. Unless he has been specifically authorized to act as the owner's agent in contractual matters, it is necessary for the owner himself to order any deviation from the plans and specifications. It is the engineer's duty, however, to advise the owner in such matters and to recommend any changes he deems desirable in the best interests of the work.

**Distribution of Construction Costs.** The cost of a construction project varies with the cost of materials, wage rates, taxes, and other factors of similar nature. Frequently, in preparing plans, specifications, and contracts, as well as in estimating, it is desirable to know the relative costs of these elements for the commonly used types of construction. The data in Table I is a breakdown of material, labor, and overhead costs on a percentage basis, as collected from the 1930 construction census by the Bureau of Census. The distribution percentages were derived from information on construction work aggregating \$5,550,000 in 1929, and it is believed that they also approximately represent present-day conditions.

TABLE I \*

## DISTRIBUTION OF CONSTRUCTION COSTS

In Percentages of Total Costs

Item	Classes of Contractors			Building Construction					Heavy Construction Classifications																	
	All classes	Operative Builders	General contractors	Sub-contractors	All building contractors	Bldg.—not specialized	Bldg.—commercial	Bldg.—mfr. & ind.	Bldg.—residential	Highways	Bridges	Grading	Street paving	Sewer & water lines	Dams & reservoirs	Waterworks	Dredging	Levees	Railroads	Foundations	Power plants	Air transport	Refuse disposal	Oil & gas lines	Subways	Telephone & misc.
1. <i>Materials:</i> Gen. Contr.	33.0	13.8	28.2	45.0	24.8	24.8	51.8	33.6	26.2	38.0	39.9	8.3	38.6	35.4	42.8	40.6	62.0	12.5	24.5	31.1	34.8	25.3	25.0	30.6	28.8	29.0
Subcontr.	10.8	29.8	13.8	1.5	18.9	18.8	92.9	15.1	11.9	3.8	3.1	0.5	3.7	8.3	3.4	2.9	2.9	3.9	3.8	4.2	15.3	5.9	5.8	6.9	3.7	1.2
Total materials	43.8	43.6	42.0	46.5	43.7	43.7	84.7	48.7	38.1	42.7	43.0	8.8	42.3	43.7	46.2	43.5	64.9	16.4	28.3	35.3	50.1	31.2	30.8	37.5	32.5	30.2
2. <i>Labor:</i> Gen. Contr.	23.6	8.3	21.6	28.9	19.3	19.3	91.7	13.0	8.3	26.6	43.6	42.1	31.6	30.3	26.2	27.6	28.1	32.9	31.1	23.9	35.4	43.1	22.8	30.2	32.7	32.7
Subcontr.	7.1	19.2	8.9	1.0	12.1	12.1	14.7	9.8	12.2	2.7	3.4	2.9	3.0	1.9	1.7	1.5	2.2	4.4	4.3	4.7	5.3	3.6	3.7	2.8	2.4	0.3
Total labor	30.7	27.5	30.5	29.9	31.5	31.5	106.4	22.8	20.5	29.3	47.0	45.0	35.6	32.2	28.3	29.1	30.3	37.3	35.8	28.6	40.7	46.7	26.5	33.0	35.1	33.0
3. <i>Salaries:</i> Gen. Contr.	5.6	2.8	5.0	7.2	4.5	4.5	4.6	4.2	4.7	3.9	5.2	5.4	7.0	6.1	6.3	6.9	6.3	10.3	5.8	8.1	6.4	10.1	6.2	4.3	5.7	7.3
Subcontr.	1.8	4.8	2.2	0.2	3.0	3.0	3.6	2.4	3.0	0.9	0.6	0.7	0.7	0.2	1.0	0.9	0.8	0.7	0.7	0.8	0.9	0.9	0.4	0.6	0.3	0.3
Total salaries	7.4	7.6	7.2	7.4	7.5	7.5	7.6	7.8	7.1	6.9	6.1	6.0	7.7	6.3	7.3	7.8	7.1	11.0	6.5	8.9	7.3	11.0	7.1	4.7	6.3	7.6
4. <i>Misc. overhead:</i> Equip. rental: Gen. Contr.	0.4	...	0.5	0.3	0.1	0.2	0.2	0.2	...	1.4	0.4	2.7	1.4	1.1	0.6	0.6	1.2	3.1	1.2	0.7	0.2	2.0	...	0.1	0.5	2.7
Subcontr.	0.1	0.2	0.1	...	0.1	0.1	0.1	0.1	0.1	...	0.1	0.9	0.1	...	...	...	...	...	...	...	...	...	...	...	...	...
Plant charges, rent, interest, bonds, insurance, etc.: Gen. Contr.	8.0	5.2	7.7	8.8	4.0	3.9	4.3	4.2	4.1	15.1	11.8	26.3	12.8	14.6	12.6	12.7	8.25	9.14	11.0	5.5	12.6	14.9	16.0	11.4	13.8	13.8
Subcontr.	2.1	5.6	2.6	0.3	3.6	3.5	4.3	2.8	3.6	1.1	1.4	2.4	1.3	0.4	0.3	0.3	1.4	1.7	1.7	1.9	1.3	1.1	1.1	1.3	0.7	0.3
Total overhead	10.6	11.0	10.9	9.4	7.8	7.7	8.9	7.3	7.8	17.2	13.7	32.6	16.7	14.3	15.5	13.3	30.4	30.7	17.6	13.6	7.0	15.7	16.0	17.4	12.6	16.8
Total Items 1 to 4	92.5	89.7	90.6	93.2	90.5	90.0	189.1	88.9	90.8	92.2	58.8	90.0	91.3	87.0	92.2	92.2	90.6	89.6	93.6	93.6	96.9	88.8	90.4	86.1	87.6	87.6
5. Balance of charges, incl. undistributed expense and profits: Gen. Contr.	5.7	2.1	5.6	6.4	4.3	4.1	3.5	6.5	5.8	7.2	6.9	10.4	9.2	7.8	11.6	6.4	7.0	7.6	8.6	5.5	5.5	2.0	10.2	9.0	13.4	11.4
Subcontr.	1.8	8.2	3.8	0.4	5.2	5.3	6.4	4.4	5.3	2.0	0.6	1.2	0.8	0.9	1.4	1.1	0.8	1.8	1.8	0.9	0.9	1.1	1.0	0.6	0.3	1.0
Total balance	7.5	10.3	9.4	6.8	9.5	9.4	9.9	10.9	11.1	9.2	7.5	11.6	10.0	8.7	13.0	7.5	7.8	9.4	10.4	6.4	6.4	3.1	11.2	9.6	13.9	12.4
Total all items	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Percentage of work sublet	23.7	67.8	31.4	3.4	43.0	42.8	52.0	34.4	43.2	10.0	9.2	8.6	9.6	5.2	7.8	6.7	8.1	12.5	12.3	13.5	23.7	12.6	12.5	12.0	7.9	3.1

\* From *Engineering News-Record*, March 21, 1935.

TABLE II \*

**DISTRIBUTION OF SUBCONTRACTORS' EXPENSES ON BUILDING WORK**  
**In Percentages of Total Value of Subcontracting Work**

Class of Subcontractor	Work Sublet	Materials	Wages	Salaries	Equip. Rental	Bonds, Insurance, Plant Charges, Rent, etc.	Undistributed Balance Incl. Profits
Carpentry and wood floors	7.5	40.5	30.0	7.8	0.6	7.2	6.4
Concrete	3.9	34.8	36.3	8.0	0.7	9.0	7.3
Electrical	0.8	44.0	31.2	9.1	0.2	8.6	6.1
Elevators	2.2	65.7	16.8	2.9	0.1	3.3	9.0
Plumbing and heating	3.2	52.0	24.4	7.1	.....	7.4	5.9
Masonry	3.2	40.1	38.6	5.6	0.5	6.3	5.7
Painting and decorating	1.0	20.6	52.0	9.2	0.1	9.0	8.1
Glass and glazing	2.2	52.0	18.4	8.5	0.1	11.8	7.0
Lath and plaster	5.8	26.0	51.0	6.2	0.3	4.8	5.9
Roofing and sheet metal	1.6	44.0	25.6	9.9	0.1	12.4	6.4
Steel erection	8.5	50.7	19.3	5.0	0.2	9.5	6.8
Stonework	4.9	36.8	32.8	8.2	0.4	9.9	7.0
Marble and tile	1.2	44.5	30.4	7.2	0.1	9.2	7.4
Wrecking	1.7	1.0	53.3	13.3	3.0	20.0	7.7
Excavating	6.5	6.2	35.8	8.2	6.2	27.8	9.3
Ornamental iron	3.8	48.3	18.6	7.6	.....	10.4	11.3
Soundproofing	1.6	52.5	18.4	7.3	.....	9.1	10.1
Flooring	1.1	47.3	26.4	7.4	.....	12.1	5.7

\* From *Engineering News-Record*, March 21, 1935.

For all classes of construction, 43.8 per cent of the total contract cost is for material, 30.7 per cent for labor wages, 7.4 per cent for salaries of executive and supervisory forces, 10.6 per cent for general overhead and plant charges, and the remaining 7.5 per cent is classed as undistributed expense and profit. Table I shows this breakdown as well as corresponding breakdowns for three classes of contractors, operative builders, general contractors, and subcontractors. The table also reveals that, on the average, 23.7 per cent of construction work of all classes is let to subcontractors.

The same breakdown of material, labor, and overhead costs is carried through various classes of heavy construction. Naturally, grading work shows the lowest ratio of material costs while bridges, waterworks, and power plants show the highest. The ratio of

overhead costs, including plant charges, is 10.6 per cent for all construction but jumps to more than 30 per cent on grading, dredging, and levee work. The balance of costs, other than materials, labor, salaries, and overhead, which includes profits, is highest on subway construction, almost twice that of the general average of 7.5 per cent.

Table II shows a separate breakdown of building costs divided into the various trades classifications usually found in subcontract work.

### Questions

1. What are some of the economic benefits which might reasonably justify the construction of the following projects?

- a.* A toll bridge.
- b.* An hydro-electric development.
- c.* The widening and deepening of a navigation channel.
- d.* An express highway.
- e.* A sewage-disposal plant.
- f.* A multi-storied office building.

2. Explain some of the conditions which might make it advisable for the Tennessee Valley Authority to adopt the force account method for the construction of a large dam during an economic depression in lieu of accomplishing the work by contract.

3. Railroad companies normally make maintenance repairs to tracks and bridges with their own forces whereas on new construction projects the work is usually accomplished by contract. Discuss the reasons leading to this procedure.

4. Why was the force account method considered advisable for the construction of the Panama Canal as compared with the employment of contractors?

5. Explain why it is usually to the best interests of the owner to adopt the general contract method for construction projects in lieu of any other method.

## 2

### LEGAL CONSIDERATIONS

The laws of the United States are of two classifications, namely, *common law* and *statute law*. Common law originated in England and was adopted as a basis for jurisprudence by the United States early in the history of this country. It is derived from traditional usage and custom as representing what is right and what is wrong in human relationships. The principles of common law have been established by gradual adoption and verified by decisions in the courts of justice, without legislative action. The recorded court decisions in previous controversies form the basis of the decision when a similar controversy arises, and thus precedent is a very important factor in defining the principles of common law. Common law is recognized by all courts, but it differs in many details from state to state. Thus the line of decisions on a certain point in Massachusetts might result in a decision on a given case in that jurisdiction exactly opposite to the decision that would be reached on the same case in Illinois.

Statutory law consists of acts or statutes established by legislative action. Statutes may be passed to clarify the common law, to remedy a defect or an injustice in common law, to repeal some tenet of common law which is no longer applicable, or to impose a penalty for a transgression. Statute laws must not conflict with constitutional provisions or with laws of higher precedence. For instance, a statute passed by a state legislature is not enforceable if it conflicts with a federal law.

In any transaction the law serves as a guide for action. When there is a misunderstanding as to the intended meaning of the law it is necessary that an interpretation be made in the light of the conditions involved in the transaction. This usually means a suit in a court of law or submission of the dispute to a board of arbitration.

Construction contracts usually stipulate that all controversies and disputes will be decided by the engineer and that his decision shall be final. It should be noted that this provision holds only as long as it is acceptable to both parties on a voluntary basis. No provision in a contract can deprive anyone of his right to submit a dispute to a court for settlement.

Laws also may be classified relative to the fields of activity or subject matter covered. Those of most general application in construction relationships are under the classification of business law, particularly the laws of contracts, torts, equity, agency, sales, insurance, and the like. Although it is not expected that the engineer should master the details and technicalities of the practice of law, it is essential that he have an appreciative understanding of some of the basic principles of business law, particularly those directly related to engineering contracts.

### *CONTRACTS*

A contract may be defined as an agreement enforceable at law. Only the parties to the agreement are bound by its terms, and no right or liability can accrue directly to a person who is not a party. However, if the contract is made expressly for the benefit of a third person, as for instance in a life insurance contract, such benefit is enforceable at law in a suit initiated by the third person. Indirect or indefinite benefits to a third person are not included in this category and are not necessarily enforceable. Third persons may also acquire rights under a contract, subsequent to its execution, by assignment, succession in office, receivership, inheritance, and the like. Contract laws vary from state to state, and the law governing a specific contract will be determined by the place where the contract was made or by the place of residence of the parties unless expressly provided otherwise.

**Essential Elements of a Contract.** In order to be enforceable at law a contract must contain the following essential elements.

- a. There must be a real agreement or "meeting of the minds."
- b. The subject matter must be lawful.
- c. There must be a valid consideration.



- d. The parties must be legally competent.
- e. The contract must comply with the provisions of the law with regard to form.

The absence of any one of these elements is sufficient to void a contract.

**Agreement.** If a contract is to exist there must be a mutual understanding and assent as to the terms of the agreement. Inasmuch as this is a mental process, the wording of the contract should express the intended meaning explicitly and clearly. The law requires that there must be a real meeting of the minds. Normally, agreement is indicated by the signatures of the parties. Under certain conditions, however, the contract may be nullified on the basis of *unreality of consent*, when there is sufficient evidence to the effect that there was no real agreement. Unreality of consent may be established if it can be shown that the agreement was reached on the basis of a mistake as to fact. A mistake as to law is not recognized since everyone is assumed to know the law. The following types of mistakes may void a contract.

- a. Mistake as to the party.
- b. Mistake as to subject matter.
- c. Mistake as to the nature of the transaction.

Unreality of consent also may be established if the subject matter did not exist when the "agreement" was made, as when a ship had been sunk before its sale had been agreed upon, or if it can be shown that one party entered into the contract on the basis of misrepresentation, fraud, duress, or undue influence by another.

**Lawful Subject Matter.** A contract may be declared illegal and unenforceable if its subject matter is contrary to the rules of common law, if it violates a state or federal statute, or if it is in opposition to established public policy. Contracts involving crime, fraud, restraint of trade (Sherman Anti-Trust Act), collusion, and pure speculation or gambling are typical examples of unlawful subject matter. Subject matter contrary to public policy is intangible and difficult to define except in an obvious case of conflict with the interests and welfare of society and the obstruction of justice. Contracts in restraint of competition or collusion in bidding in order to create a monopoly are examples of contracts

contrary to public policy. The fact that a person enters into an illegal contract unknowingly does not offer a basis for relief in case of loss or damage suffered thereby. Contracting parties are assumed to have informed themselves of all legal implications in advance of signing the contract.

**The Consideration.** In the legal sense, consideration is defined as the act or forbearance of one party in return for an act, forbearance, or promise of the other. If the consideration is real and valuable, the requirements of the law of contracts are satisfied, it being understood that the function of the law is to assure the consideration on which the contract was based but not to pass on its fairness or adequacy. That is to say, the courts will not attempt to make a bargain for the parties but will merely try to determine from the evidence what the bargain actually was. The only exception to this rule is in the matter of liquidated debts. One cannot satisfy an established debt by the payment of some lesser sum, even though an agreement was made to that effect, unless there is some *additional* consideration, such as an advance in the date of payment. When a contract requires a promise to give something other than money, one dollar in addition is customarily required in order to establish a real consideration. Unilateral promises, gratuitous promises, and impossible promises usually are not enforceable by contract law because of the absence of a real consideration. Likewise, a consideration made impossible by an act of God may be sufficient ground for the cancellation of the contract. Consideration may be stated explicitly in a contract, as for instance, a definite promise to pay a sum of money or to do some specific thing, or it may be implied, in which case the existence or the value of the consideration may be difficult to prove.

**Competent Parties.** The laws relative to competency of contracting parties differ in various states. In general, anyone acting in good faith may enter into a binding contract except minors and insane and drunken persons. A contract made with a minor is not enforceable against the minor but may be enforceable against the other party. After a minor has reached twenty-one years of age, he may affirm a contract made previously, thus making it binding. If a minor obtains possession of goods through

an illegal contract he cannot deny the legality of the contract and still keep the goods. The laws of some states consider a contract with a drunken or insane person to be legal if made in good faith and if the person knew what he was doing. Other states void such contracts without reservation. Formerly, married women were considered incompetent to contract, but this restriction has been removed universally except in some states where a married woman may not enter into a contract with her husband, marriage contracts excepted.

The matter of competency to contract is of particular importance to engineers, however, in connection with corporations. Since a corporation is a person created by law, it has only such powers as the law confers upon it, and the types of contract which a given corporation may enter into may be strictly limited. For example, a railroad may legally contract for the construction of a bridge for its tracks but may have no right to contract for the construction of a pleasure resort to attract passenger traffic. Again, the manner in which a corporation may contract may also be strictly prescribed by statute or by its by-laws, and failure to observe these forms may void a contract. Assuming that a contract with a private corporation has been found to be void because of "incompetency," the other party may still be able to recover something at law for his services if the corporation has actually made use of them; the case, however, may be costly and long drawn out. Moreover, in case of a void contract with a public corporation, for example, a city, school board, or a state, there is no possibility of recovery even in a lawsuit. It therefore behooves the engineer or contractor to avail himself of competent legal advice before entering into contractual relationship with any corporation on matters of more than casual importance.

Competency to contract is also of importance to engineers in connection with government agencies. Contracts with municipal, county, state, and federal government agencies must be made within the authority of the contracting officers representing those agencies. Contracts made outside such delegated authority are not binding on the agencies concerned even though the contracting officer was acting in good faith when he exceeded his authority. Persons entering into contracts with government agencies do so at their own risk inasmuch as no recovery is possible for work or materials furnished for a government contract in

which the contracting officer acted outside his legal authority.

**Offer and Acceptance.** A contract may be *express* or *implied*. Express contracts involve a definite offer by one party of the terms upon which he is willing to enter into contract with another. The form of the offer is immaterial from the legal viewpoint; it may be by letter or telegram, or it may be oral. The only requirement, in case of a controversy, is that there must be evidence that the offer was made, and therefore from the standpoint of good business practice the offer should be written and signed, since this is the best form of evidence. The acceptance must be equally definite, unqualified, and unconditional. A conditional acceptance terminates the offer and thus precludes a later acceptance. The conditional acceptance may, however, be considered as a new offer, which the original offeror has the option of accepting. A contract does not exist until the offer is accepted, and the offer may specify the method or other details of the acceptance. For instance, the time and place of acceptance may be made conditions of the offer. The agreement comes into existence at the instant the acceptance is communicated to the offeror or to his agent. If the offeror has used the mail to communicate his offer, the postal service becomes his agent; thus an acceptance creates an agreement the instant it is dropped in the mailbox (communicated to the agent), and it is immaterial whether the letter of acceptance ever actually reaches the offeror. At any time prior to the acceptance an offer may be withdrawn or revoked; offers may also cease to exist because of other reasons, such as the passing of a "reasonable" period of time or the death of the offeror.

An advertisement for bids by a corporation or a government agency is not in itself an offer, but a bid in response to such an advertisement is an offer which, however, creates no legal rights until accepted. Even though a municipal charter expressly requires that a contract be awarded to the lowest bidder, a contract is not formed until the lowest bid is in fact accepted. Even if the municipality can make a contract with no other than the lowest bidder, it is not compelled to make a contract with him.

A series of circumstances may be sufficient to establish an implied contract without a specific offer and acceptance, if the facts involved indicate that the parties showed a mutual intention to contract. Questions relative to implied contracts usually arise

only in cases of controversies and disputes and in most cases are settled in a court of law.

**Provisions of the Law with Regard to Form; Statute of Frauds.** This refers particularly to the requirement that certain types of agreements must be in writing, "signed by the party to be charged," before they can be enforced at law. The old English statute known briefly as the Statute of Frauds sets forth the types of contracts that must be written, and this statute has been adopted with minor modifications by all states of the Union. Principal provisions of interest to engineers, architects, and contractors are that the following types of contracts among others must always be evidenced in writing.

*a.* Contracts for sale, lease, etc., of real property.

*b.* Surety contracts to stand good for the debt, default, or miscarriage of another or in the case of an agreement of an administrator or executor of an estate to make himself personally liable.

*c.* Contracts that cannot possibly be performed within a year.

Contracts for the sale of goods, wares, and merchandise in excess of a certain dollar value (varying from \$25 to \$500 in various states) must also be evidenced in writing unless there had been a down payment or an actual acceptance of a partial delivery.

It will be noted that many important types of contracts, such as for building a house or a bridge, need not be in writing as far as the Statute of Frauds is concerned. In other words, such contracts would be legal and binding even if oral. However, good business practice dictates that all but the most trivial contracts be written and signed by the contracting parties for the purpose of record in case of disputes. This is particularly true for construction contracts where the services to be furnished are usually complex and there are many promises and conditions in the agreement. The written document should delineate the scope of the services to be performed, the consideration to be given for their performance, the time in which they are to be performed, and the signatures of the parties. Other conditions of primary importance may be included or they may be set forth in separate documents and, by stipulation, made a part of the agreement.

The signatures to the contract should be the exact names or legal titles of the parties and should be used with the addresses

of their places of business. In the case of partnerships the name of the firm and that of each partner should be stated in the agreement. The signature of the firm name by one of the partners will bind each of the partners, but additional emphasis is given if the contract is signed by each of the partners. When a corporation is a contracting party, the name of the corporation should be followed by the signature of the officer authorized to obligate the corporation through a contract. This signature should be attested by the proper officer, usually the secretary of the corporation, that the contracting officer is duly authorized to execute the contract. In contracting with a corporation it is important to ascertain that the corporation has the right to enter into the contract and that it is doing so by proper legal action. To the signature may be affixed the seal of the corporation. The use of the seal implies a consideration, and legal requirements in this connection vary. In general, unless the seal is required by law, it is better to stipulate the consideration clearly in the contract in which case it becomes unimportant whether or not the seal is used. The seal may be stamped or impressed on the paper, or it may be of the adhesive type.

**Assignment of Contracts.** A party to a contract may transfer his rights or obligations to a third person unless assignment is expressly prohibited by the terms of the agreement. Such assignment of a contract may not relieve the assignor of his responsibilities under the contract, however, except by agreement between the two original parties. In general, all contracts are assignable with the exception of contracts for the personal skill or services of one of the parties. Engineering and architectural services may fall within this category if it is clear that the personal skill of the contracting engineer or architect was intended when the contract was made. Otherwise, such contracts are assignable. Contracts for construction work almost always are assignable. Usually, however, the terms of the contract will require the owner's approval before any assignment is permitted. Payments due under a contract may be assigned to a creditor in security of a loan or debt unless prohibited by the terms of the agreement.

It is customary to provide for the death or incompetence of either of the parties to a contract by making his heirs, executors, successors, and assigns parties to the agreement. An executor

is held to be the representative of a party after his death, and the benefits and liabilities of the party can be enforced against his estate through the executor unless the contract stipulates to the contrary.

**Changes in Contracts.** A contract may be modified or changed by subsequent agreement of the parties. Moreover, most contracts for engineering services and construction work contain clauses which provide for the owner to make any change or alteration in the work to be performed, as he may see fit, subject to a corresponding change in the contract amount. Inasmuch as such changes are frequently made as the work progresses and cannot be foreseen when the contract is signed, it is necessary that the amounts to be added to or deducted from the contract price be determined by negotiation when the changes are ordered. Controversies and lawsuits frequently result when all details of changes and extra work are not settled in advance.

It should be noted that the agreement to change a contract must conform to the same basic requirements as an original contract with regard to competency of the parties, consideration, legality of subject matter, and mutual agreement. Likewise, a change order may be explicit or implied, and it is in the implied type that disputes are more likely to arise unless the scope and cost of the change are definitely established before the work is performed. For this reason, change orders should be in writing with the scope of the extra work clearly defined and the mutually agreed change in the contract amount definitely stated. The change order should also cover any change in the contract time of completion because of the extra work. This is particularly important when the contract includes a liquidated damage clause based on the specified time of completion of the work.

An alternative method for arriving at the cost of changes provides for the contractor to be paid the actual out-of-pocket expense in connection with the change plus a stipulated percentage of the cost to cover overhead and profit. This procedure frequently leads to disputes, however, and it is not recommended in general.

**Time of Completion.** If the time in which the work is to be completed is not specified in the contract, the courts will hold that it shall be performed within a "reasonable time"; this is also true when the contract states that the work shall be done "as soon as possible," "at once," or "without delay." A "reasonable

time" is indefinite and difficult to determine; therefore, it is important that the contract stipulate a definite date before which the work is to be completed or a definite number of calendar days after receipt of the notice to proceed. The latter provision should include Sundays and holidays and thereby eliminate that uncertainty as a possible source of controversy.

**Liquidated Damages.** When time is declared to be "of the essence of the contract," it is implied that the time of completion is a part of the consideration in the agreement, and failure of one party to complete his obligations within the time specified may make him liable to the other for damages. The amount of the damages may be determined by agreement or by a suit in a court of law. Such damages are difficult to determine exactly, and in construction contracts the usual practice is to stipulate a definite amount per day of delay as *liquidated damages* in lieu of a determination of the actual damages suffered. This amount, agreed to by both parties, is enforceable at law, provided that it is a reasonable measure of the actual damages suffered. The injured party, therefore, must be prepared to justify the amount; otherwise it may be changed or disallowed by the court in case of a lawsuit even though it was agreed to in the original contract. The burden of proof is on the defaulting party, however. Unjustifiable liquidated damages imply a penalty, and the courts will not assess a penalty. That is to say, time is a sufficient consideration for the actual damages suffered or a reasonable measure thereof, but there is no consideration for any amount in excess of the actual damages unless the contract contains a corresponding provision for the payment of a bonus for performance better than that anticipated in the contract.

The contractor may be excused from liquidated damages, or he is entitled to an extension of the time of completion if the owner adds extra work to the contract. Likewise, if the contractor is delayed by acts of the owner, he is entitled to an extension of time. Delays caused by other contractors on the work ordinarily are not grounds for extension of time inasmuch as most contracts require the work to be coordinated with that of other contractors in progress concurrently. Bad weather is usually assumed to be a normal hazard of construction work to be anticipated in advance and is not considered sufficient grounds for waiving liquidated damages unless it can be shown that such



weather was unprecedented and was therefore an extraordinary hazard.

**Penalty and Bonus Clauses.** Provisions for the payment of a bonus of a specified amount per day for completion earlier than the date stated in the contract and the assessment of a corresponding amount per day as a penalty for delay are sometimes included in a contract as an incentive to the contractor when the completion of the work is urgent. The courts have repeatedly held that a penalty is not enforceable without the corresponding bonus provision. Although penalty and bonus clauses are frequently encountered, their use is not recommended inasmuch as they tend to encourage speculation and usually work to the disadvantage of both parties. Such clauses are prohibited in U.S. Government contracts.

**Termination of Contracts.** Ordinarily it is assumed that a contract will be terminated when both parties have performed their obligations under the agreement. A contract may be terminated by *specific performance* in which the terms of the agreement are carried out to the letter. Work under a construction contract completed exactly in accordance with the plans and specifications and paid for at the contract price constitutes specific performance by both parties and terminates the agreement. A contract also may be terminated by *substantial performance* when, due to conditions beyond the control of either party, specific performance is impossible but one party has performed his obligations to substantial completion and is entitled to receive payment in full or with minor deductions, provided that no damage has been suffered by the other party. Substantial performance will not be recognized when the contractor has not attempted to comply with the specifications, when he has willfully or fraudulently departed from the plans, or when his work has been performed in a careless or negligent manner.

**Termination by Agreement.** In lieu of performance, the parties may agree to the termination of a contract at any time in its life. The termination agreement may be based on a *waiver* where the parties agree to waive all their rights and obligations under the contract at a specific time. It may be based on a *substituted agreement* where a new contract replaces the original agreement. It may be based on *payment in lieu of performance* where one party pays a negotiated amount of money to the other in lieu

of the performance of his required obligations. A contract termination agreement may also be based on *accord and satisfaction* in which one party agrees to accept a substitution in the obligations of the other.

It should be noted that all U.S. Government contracts contain a clause providing for the termination of the contract at any time it appears to be in the government's interests to do so. Many private contracts have similar clauses. This constitutes termination by agreement (in advance of actual termination) in which an incomplete portion of the work under the contract is accepted in lieu of complete performance. The work completed at the time of such termination is paid for on the basis of a negotiated price satisfactory to both parties or on the basis of a prearranged method of settlement set forth in the contract.

**Termination by Breach.** If one party either fails or refuses to perform his obligations under the contract or when his acts make performance impossible, the contract is terminated by *breach*. The defaulting party thereby becomes liable for damages incurred by his failure to perform his obligations. Moreover, the other party may be relieved of all liabilities and obligations because of the breach of the contract. Settlement of a breached contract may be accomplished by negotiation and agreement (accord and satisfaction), or it may require litigation in a suit for damages. When the performance of a contract is guaranteed by a surety, such as a bonding company, the surety becomes liable for any damages or for the performance of the contract in case of a breach by the bonded party. In the case of a *conditional contract*, that is, a contract the performance of which is conditioned on the happening of some act or event, a breach of the condition by the promising party excuses the other party from further performance under the contract and, in effect, breaches the entire contract. Accordingly, the injured party may recover any damages suffered thereby.

**Termination by Impossibility of Performance.** A contract may be terminated if conditions unforeseen when the agreement was made preclude performance. For example, subsoil characteristics previously assumed to be satisfactory for a bridge pier foundation may be determined unsuitable after the signing of the contract, making the construction of the pier impossible, and such a contract could not be enforced. On the other hand, bad weather

may preclude the construction of asphalt paving, but unless it can be definitely shown that such bad weather was abnormal and unprecedented for the specific location and unforeseeable when the contract was made, the courts would normally find it to be a hazard of the contract rather than an impossible condition. Impossibility of performance is usually difficult to substantiate, and the burden of proof is the responsibility of the defaulting party.

**Termination by Operation of the Law.** A contract also may be terminated before completion by the operation of such laws as those pertaining to bankruptcy, the Statutes of Limitation, the laws of inheritance, and the like. Ordinarily, contracts are not affected by the death of one of the parties inasmuch as his obligations are transferred to the executor of his estate and to his heirs. Contracts for the personal services of one of the parties, however, are terminated by his death.

### TORTS

A tort may be defined as a civil wrong which, in violating the private personal rights of an individual, inflicts injury or damage to his person or his property. In such a case the law gives the injured person the right to bring civil suit for damages as compensation for the violation. It should be noted that a tort is distinguished from a crime or a misdemeanor in that it is an offense against an individual rather than against the state, and the injured party must himself seek redress. However, a tort may also be a crime as in the case of physical assault. Torts may be classified as follows.

- a. Personal wrongs, such as slander, libel, and fraud.
- b. Trespass, such as the violation of one's property, patents, or copyrights.
- c. Nuisance, which is an act causing injury or annoyance to a person or to his property although the act may be committed elsewhere rather than on his person or property.
- d. Negligence, which is the failure to observe the necessary care and vigilance to protect the interests and rights of another person.
- e. Violation of water rights, right of support (foundation conditions not to be disturbed), and the like.

Whereas the laws of contracts state that a person must do what he has agreed to do, the laws of torts may prohibit him from doing certain things which violate the natural rights of others. These natural rights may be defined by either common law or statute law, or they may not be defined specifically, in which case it will be up to a court to determine whether or not a wrong has been done.

**Discharge of a Tort.** Like a contract, a tort may be discharged by any of several methods. Inasmuch as the affected parties are the only ones concerned the method of discharge is not prescribed by law. The following are the common methods of settlement.

- a. By a civil suit for damages.
- b. By arbitration and agreement.
- c. By death of either party (unless statute law provides that the tort shall survive the death of either party).
- d. By bankruptcy (except in the case of fraud and willful malicious wrongs).
- e. By a Statute of Limitations which discharges the tort automatically if no action is started to recover damages within a specified period after the occurrence of the injury. This period of time varies in different states. The object of a Statute of Limitations is to require a person who has been wronged to enforce his rights within a reasonable time or to waive them.

## EQUITY

It is a matter of record that the common law does not cover every possible case and that in some instances it is inadequate and in others unduly harsh. The common law may provide a remedy after a wrong has been committed, but there may be no procedure under the common law to prevent such a wrong from being committed even when that intention is known. To provide for these deficiencies in the law, recourse may be had in a court of equity. Thus a court of equity may recognize rights not recognizable in common law and may apply remedies for which no provision is made in common law. The primary objective of a court of equity is to see that justice prevails. In general, the same judge may try cases both in law and in equity, the court being converted from

one in law to one in equity by declaration when there is no adequate remedy at common law. In a case in common law, it is the duty of the judge to determine the applicable law, and the facts are determined by a jury, whereas in equity it is also the judge's duty to determine the facts. By consent of the court, however, the questions of fact may be referred to a jury. The party who brings suit in a court of equity is called the *complainant* corresponding to the plaintiff in a court of law. The party being sued is called the defendant as in a court of law.

The types of cases within the jurisdiction of a court of equity may be classified as follows.

a. Equitable titles, involving trusts, mortgages, foreclosures, assignments, and the like.

b. Equitable rights, relative to liens, adjustments, mistakes, fraud, etc.

c. Equitable remedies, such as specific performance of contracts, injunctions, partition of land, receiverships, partnership bills, bills of accounting, and protection of infants.

**The Maxims of Equity.** In equity, maxims of broad general rules or principles are recognized and enforced. In some states they have been incorporated into the state code and made matters of statute law. They are subject to limitations and exceptions, however, and may limit or restrict each other.

The following are some of the maxims of equity.

He who seeks equity must do equity.

He who comes into equity must come with clean hands.

Equity aids the vigilant, not those who slumber on their rights.

Equity acts specifically.

Equity follows the law.

Equity delights to do justice and not by halves.

Equity will not suffer a wrong to be without a remedy.

Equity regards that as done which ought to be done.

Equity regards substance rather than form.

Equity imputes an intent to fulfill an obligation.

Equity is equality.

Between equal equities the law will prevail.

Between equal equities the first in order of time shall prevail.

**Equity Jurisdiction in Engineering and Construction Work.** The laws of equity are of great importance in engineering relationships. The assignment of contracts and the assignment or subrogation of funds due under a contract to cancel a debt are common business practices within equity jurisdiction. Certain types of mistakes of fact if not caused by negligence may be rectified by a court of equity. There is no relief in equity for mistakes of law. Frequently injunctions are encountered in engineering and construction work to prevent torts, to cause a change in construction plans, to prevent the violation of water rights, and the like. An injunction is usually temporary, pending a hearing on its merits, and must be obeyed until a final judgment is reached by a court of equity. Likewise, questions pertaining to penalties and liquidated damages in construction contracts will usually be subject to settlement by a court of equity. The re-writing of lost documents, the cancellation of contracts involved in fraud, the infringement of patent rights, and the dissolution of partnerships are among the many other matters within the jurisdiction of equity on which the engineer must be informed.

### SALES

A sale is an agreement whereby the seller transfers the property in goods to the buyer for a consideration called the price. A sale agreement is subject to all the requirements of a contract relative to competency of the parties, mutual assent, legality of subject matter, and consideration. If there is an absence of consideration, the transfer is a gift.

A *contract to sell* differs from a sale in that the title is not transferred by the mere agreement; instead the seller assumes a contractual obligation to make the transfer of title, and the buyer assumes a contractual obligation to accept the title at a future date. A contract to sell becomes a sale when the title passes.

The time at which title to the property passes from the seller to the buyer is of great significance in the law of sales. Responsibility for the loss or damage of goods in transit from the seller to the buyer, for instance, is placed on the party who possessed title when the loss or damage occurred. Title passes when the parties intend it shall pass, and sales agreements should be explicit in this regard. If the parties intend title to pass at the

time of the bargain, it will pass at that time although delivery may not have been made or the price paid. In conditional sales, possession may be obtained upon the payment of a down payment, for instance, but title to the property is not transferred until the final payment is made. In most states a cash sale implies the immediate transfer of title while C.O.D. sales constitute contracts for sale in which title passes when payment is made.

In the absence of any provision to the contrary, the transaction will be classed as a sale when specific goods owned by the seller are accepted and paid for by the buyer. When either delivery of the goods or the acceptance and payment therefor is promised in the future, most courts hold that the transaction is a contract to sell, and title does not pass until the conditions of the contract are fulfilled. For goods to be specific they must be in existence, be owned by the seller, and be so described in the agreement as to be readily identified and distinguished from other goods of the same kind belonging to the seller.

The law of sales deals with personal property as distinguished from real property. Real property consists of land and all rights or interests therein which are objects of ownership. Liens on land are classed as personal property because they are incident to the debts which they secure. Land includes all those things attached to the land permanently, such permanency being evidenced by the intention of the person making the annexation to attach the thing to the land as a permanent part thereof. Property of every other kind is personal. The old division of property into movable and immovable things expresses the same idea. Movable things are always personal property. It is obvious that rules of law applying to the sale of land must be different from the rules which govern the ownership of movable property. Land cannot be transferred by delivery.

Distinction must also be made between a sale, a contract to sell, and a *contract for labor and materials*. In many types of construction contracts, the contractor agrees to furnish a complete structure such as a bridge or a building for a stipulated price. The contractor retains a lien on the structure during its construction and is responsible for it in every way until title is accepted by the owner upon its completion and the contractor receives final payment for his work. Although the owner, in effect, buys a com-

pleted structure from the contractor in such a transaction the law of sales does not apply. Reasons for this interpretation vary, but one frequently stated is that the labor required during construction is part of the consideration. An important result of this interpretation is that the Statute of Frauds does not apply in contracts for labor and materials. Distinction between sales contracts and contracts for labor and materials is also important in the case of purchases and subcontracts under construction contracts. Subcontracts should always be subject to the approval of the owner whereas direct purchases by the contractor of materials for construction are usually made independently of the owner, the only condition being that the purchased materials shall meet the requirements of the specifications.

**Conditions of Sale.** The maxim, *caveat emptor* (let the buyer beware), is as old as the common law itself. Today, however, nearly all important trade transactions are based on certain critical conditions, expressed or implied. A sale rarely takes place without some conditions or warranties as to quality, utility, or other characteristics of the commodity sold. Conditions relative to payment and delivery are also common. Where an implied warranty is presumed to exist, the burden of proving that it did not exist is on the seller. Where an express warranty is alleged, the burden of proving its existence is on the buyer. In a contract to sell, as in any other contract, there may be inserted such conditions as the parties agree upon. Sale on approval is one in which it is a condition precedent to the passing of title that the goods prove satisfactory to the buyer.

**Responsibilities of the Seller.** The conditions of sale which may be enforced against the seller are those related to the delivery of the goods. The property may be a specific article, and, if so, this and no other must be furnished. It may be goods with specific characteristics as when structural steel with definite physical properties is purchased for the construction of a bridge. Unless the specified properties are furnished the conditions of the sale are not fulfilled. Opportunity must be provided by the seller for inspection of the goods. Another common condition of sale is that the article must be suitable for a given purpose. In this case responsibility is placed on the seller unless provision is made for *sale on approval* where the buyer may take temporary



possession of the article but may return it to the seller within a specified time if it should prove to be unsuitable.

**Responsibilities of the Buyer.** The conditions of sale which may be enforced against the buyer are those related to acceptance of the property and payment therefor. Failure to accept and pay for property in accordance with the agreement constitutes a breach of the contract, and the defaulting buyer is liable for damages. Other remedies of the seller include the right to stop the goods in transit if it appears that the buyer may fail to accept or pay in accordance with the agreement, or he may attach the goods in transit. If title has passed, the risk of accidental loss or damage rests upon the buyer.

### AGENCY

The laws of agency deal with the conditions whereby one person may represent another or act as his agent in certain types of business transactions. An agency relationship exists by agreement, and the requirements with regard to competency are the same as those for other types of contracts. An agency may be established by implication, or it may be created formally by the issuance of a *power of attorney* in which case the agent is known as an *attorney-in-fact*. Anyone who is competent to act in his own behalf may be designated as an agent or an attorney-in-fact inasmuch as the latter term does not have professional implications. The person for whom an agent acts is known as the principal.

**Authority and Duties of an Agent.** It is the responsibility of the principal to define the scope of the agency in clear unmistakable terms, and the authority of the agent is limited to the scope so defined or to the acts necessary to accomplish the purpose of the agency. Anyone may refuse to transact business with an agent, but if he accepts the agent in lieu of the principal, it is his responsibility to learn the limitations of the agency or to suffer the consequence of not doing so. Secret instructions in conflict with the agent's apparent powers do not bind an innocent party doing business with the agent, however. It is the agent's duty to represent his principal with honesty, loyalty, and diligence, employing competent skill and keeping the principal informed on all matters affecting his interests since any notice given to an agent

is the same as if given to the principal. Negligence in the performance of his duties constitutes a tort on the part of the agent, and he is liable to a suit for damages. A similar situation exists with regard to an agent's failure to consider the rights of others in carrying out his duties under the agency. In the case of an *undisclosed principal* in which the agent does not reveal the fact of his agency he assumes full responsibility for all his acts as an agent.

**The Engineer as an Agent.** The engineer as ordinarily defined in construction contracts is an agent of the owner. This is true regardless of whether he is a consultant retained on a professional basis or an employee on a salary. As an agent he is required to exercise care, skill, and diligence in carrying out his specified duties. The question then arises as to his responsibilities and the required degree of his proficiency under the agency and as to how these elements are to be measured. In general, it may be said that the engineer is expected to possess reasonable skill in the practice of his profession but that perfection is not demanded. If through negligence or lack of diligence errors are allowed to occur, the engineer is liable for damages to his employer inasmuch as this would be considered a tort. A situation of this sort would exist where the engineer failed to inspect construction operations properly or failed to enforce the provisions of the specifications when so charged by his agreement with the owner. The foregoing presupposes that the engineer actually has the necessary skill to accomplish the purposes of his agency but fails to use it. If, on the other hand, he obtained his employment upon his representation of skill which he did not possess, he is liable to his employer for breach of contract, or possibly for the tort of fraud, inasmuch as the possession of skill was one of the conditions of the agreement. As in the practice of medicine and law, the charge of malpractice of engineering usually is difficult to prove, and it is assumed not to have occurred until so proved.

It is also important to note that the engineer may be subject to criminal charges if, through negligence, he is the cause of serious personal injury or death, such as might occur in the event of the failure of a bridge or dam when the cause of the failure can be traced to his negligence in not applying ordinary engineering skill and care when the structure was built.

### THE PRINCIPLE OF THE INDEPENDENT CONTRACTOR

Under an agency relationship, the principal controls or directs the methods and acts of the agent, or when such control is not exercised directly the agent is empowered to act for the principal as if it were. The principal under these conditions becomes responsible for the acts and torts of the agent within the scope of the agency. In contrast to this arrangement the principal may be represented by another person in the accomplishment of certain acts or work under an agreement whereby the principal specifies the results to be obtained but exercises no control or direction as to the methods by which these results are to be accomplished. Such a representative is known as an *independent contractor*. The acts and torts of an independent contractor do not obligate the principal (with certain exceptions listed below), and the principal is not liable for any damages caused thereby. In general, it is the intention of every construction contract to make the contractor an independent contractor and not an agent. Therefore, it is of prime importance that the terms of the contract and the provisions of the specifications do not remove too much of the control of the work from the contractor. Particular reference is made in this connection to the tendency of many specification writers to give the engineer authority to prescribe construction methods and to control the hiring and discharge of the contractor's workmen. If this is carried too far, it may be possible, in case of difficulties, for the contract relationship to be changed from that of the independent contractor to one of agency, thereby shifting the responsibility for the contractor's torts to the owner in opposition to the original intention of the contract. It is general practice for the owner to reserve the right of general supervision over the work, and this is considered permissible under an independent contractor relationship as long as no attempt is made to exert control over the workmen in the method and manner in which they perform their duties. The engineer or an inspector may inadvertently waive the owner's rights by telling the contractor or his employees *how* to do a certain piece of work.

The exceptions to the general rule whereby the principal is held harmless for the torts of an independent contractor are:

*a.* When the only means for accomplishing a specified result are injurious to a third party.

*b.* When the principal employs an independent contractor to accomplish a specific result which is injurious to a third party.

*c.* When the principal employs a contractor professionally unqualified to perform the work required and a tort results from the contractor's incompetence. For example, the principal may be held liable in the case of damages arising from defective plans prepared by an incompetent engineer employed as an independent contractor.

*d.* When the principal is under a duty to another and engages an independent contractor to perform that duty and the contractor defaults.

**The Subcontractor as an Independent Contractor.** When a subcontract is executed on an independent contractor basis, the question arises as to the responsibility for torts committed by the subcontractor. Under these conditions it is generally held that the prime contractor is responsible for any loss or damage suffered by the owner or a third party through the methods utilized in construction. This is true even though the damage may be the result of acts of the subcontractor or his workmen. The prime contractor in turn may hold the subcontractor liable, but it is his first responsibility to protect the owner, recovering for himself such compensation for the damages as is possible under the conditions of the subcontract. In general, a subcontractor acting as an independent contractor and not as an agent of the prime contractor is liable to the prime contractor with respect to torts just as the prime contractor is liable to the owner.

**Contingent Liability.** Although the laws of agency hold an independent contractor liable for torts committed in connection with the performance of the contract, the owner is not completely protected thereby. In a suit for damages he may be held jointly responsible with the contractor, or he may be sued direct by the injured person on the grounds that the contract relationship is one between the contracting parties and is irrelevant to a third person. This is consistent with the law of contracts which states that a contract between two parties cannot obligate in any way a third person who is not a party to the agreement. Thus, under a construction contract, the owner may hold the contractor

responsible for any damages arising from the work, but the owner himself may be held jointly or wholly liable by an injured third person. Likewise a prime contractor may be held liable for damages caused by a subcontractor. This is termed *contingent liability*.

### EMPLOYER-EMPLOYEE RELATIONSHIPS

The basic laws governing the relationships between employer and employee are derived from the English common law of master and servant. These are devoted to such matters as terms of service, dismissal, responsibility for the negligence of employees, responsibility for injuries to employees, and payment of wages. The laws of most significance in connection with construction contracts, however, are those covered by employees' liability acts, workmen's compensation acts, the National Labor Relations Act, and the Social Security Act, and, for U.S. Government contracts, the Minimum Wage Act, the Non-Rebate of Wages Act, and the Overtime Compensation Act.

**Employer's Liability Acts.** Under the old common law an employer was held responsible for injury to an employee only if it could be shown

- a. That the employer was negligent.
- b. That the injured employee was not negligent.
- c. That the accident was not caused by a fellow worker.
- d. That the injured employee had not assumed the risk of his employment.

The development of the mechanized methods of modern industry was accompanied by a serious increase in the frequency of industrial accidents. Because of the complexity of the new processes it became evident that the older concept, whereby the employee was assumed to foresee the dangers of his occupation, was no longer practicable. The most frequent causes of accidents were found to be in the operation of machines by careless or improperly trained employees, hazards from improperly guarded equipment, and fatigue arising from the monotonous processes of mass production which cause a loss of alertness in the operator. To overcome the deficiencies of the old common law, employer's liability laws were enacted to place a number of additional responsibilities on the employer. Under these laws the employer

was obliged to furnish the employee with safe working conditions, proper tools, and competent fellow workmen. The employer was held liable for damages for personal injuries to an employee caused by defects in plant equipment or by the acts of an incompetent fellow worker. In general, an employer is not liable for a tort committed by an employee unless the employee has been given sufficient authority to class him as an agent.

Although employer's liability laws resulted in some improvement in protection to employees it failed notably in some respects. Contributory negligence on the part of the injured workman still remained to void a part or all of the employer's liability. Furthermore it was usually necessary for the employee to retain a lawyer to litigate his case, and frequently a large part of the damages awarded would be consumed by legal expenses. Fellow employees were reluctant to give evidence which might be objectionable to the employer. Long delays were encountered in obtaining court judgment, and there was no consistency in the various courts as to the amount of damages and the injury suffered. These deficiencies led to the enactment of workmen's compensation laws which have now been adopted by all the states.

**Workmen's Compensation Acts.** Although workmen's compensation laws vary somewhat from state to state the essential elements are common in general. These laws recognize that the employer should bear the costs of industrial accidents and provide for prompt settlement of claims, irrespective of whether or not the accident was caused by the employer's negligence and irrespective of any contributory negligence on the part of the employee. In addition to the payment of benefits for injuries, provision is also made for medical and hospital expenses in connection with the injury. The laws cover industrial workmen primarily, and some occupations, such as farming and domestic service, are excluded. Usually some form of workmen's compensation insurance carried by the employer is mandatory thus guaranteeing prompt payment to the employee in case of injury. In this connection an employee is defined as one who works for another who obtains profits from his services. Careful distinction must be made between an employee and an independent contractor in this regard.

Compensation benefit payments usually start after a period of one week of disability after the accident and will usually be from

50 per cent to 66⅔ per cent of the weekly wages in the case of temporary disability, with a maximum in most compensation acts of \$18 per week. For a permanent partial disability the benefit will run for a specific number of weeks. For a permanent total disability the compensation may be paid for life, or settlement may be made on the basis of the payment of a lump sum. If a worker dies as a result of the accident the compensation is usually paid to his dependents for a period of about six years or on the basis of a lump sum settlement. Intoxication, willful intent to injure himself or another, and failure to use safeguards provided for his protection may disqualify an injured employee from receiving compensation benefits.

The administration and control of a workmen's compensation act is usually vested in an industrial accident board appointed by the governor of the state. Provision is made in some states, however, for workmen's compensation to be within the jurisdiction of a court.

**National Labor Relations Act.** The steadily increasing frequency of labor disputes and consequent labor unrest, strikes, and other costly interruptions to the progress of industry and commerce led to the adoption of the National Labor Relations Act, approved July 5, 1935. This act was designed to protect workmen against unfair labor practices, which the act defined as follows.

*a.* To interfere with, restrain, or coerce employees in the exercise of the right of self-organization, to form, join, or assist labor organizations; to bargain collectively through representatives of their own choosing and to engage in concerted activities for the purpose of collective bargaining or other mutual aid or protection.

*b.* To dominate or interfere with the formation or administration of any labor organization or contribute financial or other support to it (for the purpose of exerting influence or control by coercion).

*c.* By discrimination in regard to hire or tenure of employment or any term or condition of employment to encourage or discourage membership in any labor organization. An employer may, however, make an agreement with a labor organization to require, as a condition of employment, membership therein if the labor organization is the authorized representative of the employees for collective bargaining purposes.

*d.* To discharge or otherwise discriminate against an employee because he has filed charges or given testimony under the National Labor Relations Act.

*e.* To refuse to bargain collectively with his employees.

For the purposes of collective bargaining, representatives are selected by a majority of the employees in a unit, and the representatives so selected are recognized as representing exclusively all the employees in the unit. Individuals have the right, however, to present grievances to the employer independently.

This act also created a board known as the National Labor Board, composed of three members to be appointed by the President and authorized to carry out the provisions of the act. Whenever it is charged that any person has engaged in any unfair labor practice, the Board has the authority to investigate the complaint and take such action as necessary to enforce the policies of the act. This may include petition to any circuit court of appeals which then takes jurisdiction of the case with the power to enforce the act. When supported by evidence the findings of the Board as to facts are conclusive.

**Social Security Act.** The Social Security Act, approved August 14, 1935, and its subsequent amendments, provides old age insurance for the benefit of workers who have reached the age of retirement. Under this act, deductions are made from the worker's pay by his employer, and the employer is also assessed a certain amount, on a percentage basis, of his payroll. The combined amount of the employee's and the employer's contributions is paid to the federal government as a tax to cover Old Age and Survivor's Insurance. The act was designed primarily for the protection of industrial workers for whom old age and retirement compensation was not available previously. Non-industrial employees, such as farm workers, domestics, government workers, and the like, are not included. All other workers who are employed on a salary or wage basis are covered, including the employees of engineers, architects, and contractors. It is the responsibility of the employer to pay to the government both the employer's and the employee's assessment. The operation of the Social Security Act is complex, and the details of its application for any specific employer are best determined by referring to the



Social Security Board of the Federal Security Agency under whose cognizance the act is administered.

**Labor Laws Unique to U.S. Government Contracts.** In recent years statute laws have been adopted by Congress imposing conditions on U.S. Government contracts which are not, in general, required under private contracts. These laws were designed to regulate the wages, hours, and employment conditions of workmen on U.S. Government projects. Those having the most important bearing on construction work are as follows.

*a. The Davis-Bacon Act* of March 3, 1931, as amended August 30, 1935, requires that mechanics and laborers receive not less than prevailing wages as determined by the Secretary of Labor. Decisions as to prevailing wages are made for specific contracts and are not changed during the life of the contract. The payment of the minimum wage rates so determined is made one of the conditions of the contract.

*b. The Copeland Act* of June 13, 1934, prevents kick-back of wages. This law requires that no employee may be induced to give up or return any part of the compensation to which he is entitled, by force, intimidation, threat of dismissal, or by any other manner whatsoever.

*c. Overtime Compensation* (Section 303 of the Second Supplemental National Defense Appropriation Act, 1941, approved September 9, 1940). This provision requires that, notwithstanding any other provision of law, the wages of every laborer and mechanic shall be computed on a basic day rate of eight hours per day, and, upon working in excess of eight hours a day, compensation shall be permitted at not less than one and one-half times the basic rate of pay.

### MECHANIC'S LIENS

The laws of mechanic's liens are designed to protect workmen, material suppliers, and, under certain conditions, engineers, architects, contractors, and subcontractors. They are statute laws and vary from state to state. In general, it is held that anyone who has contributed to or increased the value of real estate through his personal services or by furnishing materials to be incorporated into the property has a claim against the property for priority of

payment of the price and value of the services performed and the materials furnished. Thus a mechanic's lien is somewhat of the nature of a mortgage. It should be noted in this connection, however, that a contract, either express or implied, in which the owner agrees to the performance of the work on which the services and materials are furnished is a condition precedent to the enforcing of a lien. A lien may be discharged by the payment of the obligation, but if this is not done the lienor may force the sale of the property in order to recover payment for his services. Therefore, the owner may be made to suffer loss if the contractor should fail to pay his workmen. As a protection against this possibility construction contractors are usually required to furnish security to the owner in the form of a payment bond. Public property is not subject to liens as such action would be contrary to the public interests. Money due a contractor or subcontractor for construction work on a public project is subject to liens, however. Ordinarily lien rights are not affected by changes in ownership of the property, the death of the owner, or the assignment of the property for the benefit of other creditors.

**The Contractor as a Lienor.** The legal rights of a contractor to claim a lien vary to such an extent in state statutes that it is impossible to define them in general. Usually the question will hinge on whether the labor required to install the materials is relatively large or small in amount, it being necessary to distinguish between original contractor and material vendor. In order to qualify for a lien the contractor must show that the obligations of the contract have been substantially performed and that the work has been approved by the engineer, when the contract so requires.

**The Subcontractor as a Lienor.** The rights of a subcontractor to protection by a lien are even more complex than those of a prime contractor. In some states a subcontractor may claim a direct lien on the property, but others require that the prime contractor shall be entitled to a lien as a condition precedent to the enforcing of a lien in behalf of a subcontractor. Default of the prime contract by either the owner or the prime contractor, requirements as to the recording of the prime contract, and the terms of the prime contract are all matters bearing on the lien of a subcontractor and must be investigated in the light of the statute of the state in which the work is performed.

**Engineers and Architects as Lienors.** Ordinarily the right to the protection of a lien can be extended only to those who participate in the physical improvement of real estate. This principle has been interpreted by many courts to include the services of engineers and architects who superintend construction work. It is generally considered that design and the preparation of plans and specifications without superintendence of construction do not qualify the engineer for lien protection. This interpretation is based on the condition that such services are separate and distinct from the improvement of the property although they may define the methods for such improvement. By agreement between the engineer and the owner, however, it may be possible to extend lien protection to the engineer for services of this character which are not allowable normally under the lien laws.

**Priority of Liens.** Like other questions in connection with liens the matter of priority of payment is treated individually by the various state laws. Usually, however, workmen and material vendors will have priority over other creditors when an owner or a contractor defaults. Also, day laborers and material men will usually have priority over contractors and subcontractors regardless of the respective dates on which the liens are filed. Workmen and material vendors are given priority among themselves in the order in which their liens are filed.

### *LITIGATION*

Disputes frequently occur during the performance of construction contracts because of conflicting interpretations of the plans and specifications. A great deal can be accomplished in reducing the causes of disputes by exercising proper care in the preparation of the contract documents, but it is generally recognized that the perfect set of plans and specifications have not been and probably never will be devised. Therefore, disputes are always to be expected, and consideration must be given to methods for their settlement.

The contract often provides that the engineer will be the interpreter of the plans and specifications and that his decisions will be final. When questions arise as to the quality of materials and workmanship, the engineer's decisions are usually accepted, but in disputes relative to extra work, time, liquidated damages,

and the like, the jurisdiction of the engineer is limited, and other means of settlement are necessary.

If neither party yields and the dispute cannot be settled by negotiation or by compromise, recourse may be had in a court of law. Lawsuits are expensive to both parties. Moreover, the formalities of litigation result in long delays in the settlement of the dispute and frequently in the performance of the contract as well. Therefore, the engineer should exert every reasonable effort to settle the dispute so as to avoid litigation. This will almost always be to the best advantage of both the owner and the contractor.

In a lawsuit arising from a contract which permits more than one interpretation, the court will try to determine the original intentions of the contracting parties, and these will govern. When the original intentions cannot be clearly determined, the court will attempt to determine all the facts in the case from the available evidence and will render a decision in the light of the law which governs the contract. In general, if more than one interpretation is possible, the contract will be construed most unfavorably against the one who prepared it.

**The System of Courts.** The administration of the law is accomplished through a system of courts, each classification of which is empowered to hear only a specific line of cases or disputes while another line of cases involving different amounts or arising between different parties or being of a different nature will be determined by entirely different courts. The power to hear, to determine, and to enforce its judgment in a case is called the *jurisdiction* of the court. It is essential that the particular court before which a question is brought for determination shall have jurisdiction. Otherwise, its decision is of no effect and may be set aside. The following are the principal classes of courts in the United States.

*Courts of original jurisdiction* have authority to hear and to determine questions when they are first presented for judicial determination. Courts of original jurisdiction may be either *civil courts* or *criminal courts*. Civil courts hear cases in which the rights and liabilities of individuals toward each other are in dispute. Criminal courts are those which administer criminal-law and hear and determine criminal cases.

An *appellate court* generally has no power to hear a case when it first arises. It can only review the decision of a lower court when such a decision is brought before it for determination. The taking of a case from a lower court to a higher one is called an *appeal*.

*Federal courts* hear cases arising under the United States Constitution, laws, and treaties and between citizens of different states. The judicial power of the United States is vested in the Supreme Court and several inferior courts which are known as circuit courts and district courts.

**Disputes under Private Contracts.** In private construction, disputes may arise in connection with any phase of the work, but the common sources of controversy are the amounts to be allowed for changes and extra work, the existence of subsurface conditions materially different from those shown on the plans, the extension of time for changes or extra work and for delays due to conditions beyond the control of the contractor in relation to the assessments for liquidated damages. If the decision of the engineer should not be acceptable to one of the parties and if all efforts to arbitrate or compromise the dispute should fail, the only alternative would be a legal action before the local court of original jurisdiction. This will be the district, county, or circuit court, depending upon the local designation. The suit will then be tried before a judge of the court or before a judge and a jury, as predetermined by the contending parties. In a lawsuit questions as to the law of the contract are always decided by the court. Questions of fact are decided by the jury on the basis of evidence submitted. If the court decision is considered erroneous, appeals may be made to the higher courts in accordance with the legal provisions for such action. Similar procedure is followed in disputes under public works contracts with the exception of those with the U.S. Government.

**Disputes under U.S. Government Contracts.** The standard U.S. Government construction contract form stipulates that the contracting officer of the agency having cognizance over the work shall decide all disputed questions of fact. If the contractor should disagree with the decision of the contracting officer, he has the privilege to appeal in writing within a specified period, usually thirty days, to the head of the department concerned. The decisions of the contracting officer and the head of the department

are final with respect to questions of fact. Questions as to the law of the contract may be decided by the Comptroller General or the Court of Claims. If the decision is against the contractor he may, at any time within six years, file suit in the Court of Claims in Washington. If the amount of the claim is less than \$10,000 the suit may be filed in a district court of the United States in lieu of the Court of Claims. At any stage of the proceedings for the settlement of a claim, the contractor is entitled to representation by an attorney if he so desires.

It should be noted that no contracting officer has the right to settle claims for damages caused by acts of the government. Claims for damages in connection with work under contracts with the government always have to be settled by the Court of Claims. Congress initiates special legislation to provide an appropriation for their payment. In general, congressional operating appropriations may not be used for the payment of damages by contracting officers.

**Pleading and Practice.** Courts conduct their business in accordance with certain prescribed rules of practice. A lawsuit is instituted by an *action* or *suit*, which is the legal and formal demand of one's right made upon another party and insisted upon in a court. The party who brings the action is known as the plaintiff, and the one against whom it is brought, as the defendant. An action is commenced by the service of a notice called a *summons* upon the defendant. The summons is in some jurisdictions issued by the judge or clerk of the court while in other jurisdictions it may be issued by the plaintiff's attorney.

After an action has been started, the parties serve their pleadings by which both plaintiff and defendant present their respective versions of the question in dispute.

The *complaint*, sometimes called the petition or declaration, which is the first pleading in a case, consists of a statement of the cause of action in which the plaintiff sets forth his reason for seeking the aid of the court against the defendant. The complaint is commonly served with the summons but may be served later. After the complaint has been served upon the defendant or filed with the court, it is then necessary for the defendant within a certain number of days to file or serve a statement of the reasons why he should not comply with the demands of the plaintiff. If such a statement is not filed, the plaintiff is given judgment against

the defendant by default. The pleading which is filed by the defendant may be either an answer, a motion to dismiss, or a demurrer.

The answer, or plea, is a statement of the defendant's defense to the matters set up in the complaint. It may deny the plaintiff's claim, or it may admit it and set up other facts by way of counterclaim. When a counterclaim is alleged, the plaintiff, if he wishes to deny it, makes a reply or replication. After the pleadings are served the case comes to trial.

After a jury has heard the witnesses and considered the evidence, it arrives at a decision called the *verdict*. The judge then gives the judgment which is the official decision of the court upon the respective rights and claims of the parties of the action.

After the judgment has been rendered, the law provides a method of procedure, called an *execution*, for the enforcement of the judgment. This is an order by the court to one of its officers, either a sheriff, constable, or marshal, authorizing him to collect the amount named as damages and, if not paid, to take certain property of the party against whom the judgment is given, sell it, and apply the proceeds upon the judgment. The taking of the property under the authority of the execution is called a *levy*. The property after being levied upon is advertised by the officer and sold at public sale to the highest bidder. Certain articles, such as clothing, household articles of a certain value, and tools of trade owned by the debtor, are exempt from execution and sale.

The unsuccessful party in a lawsuit may within a certain time move for a new trial, either because new evidence has been discovered or because of some error of the judge, at trial. The judge may, at his discretion, order a new trial. The party dissatisfied with the judgment of the trial court may take an appeal to a higher court by complying with certain conditions. When the case has been taken to the highest appellate court to which a case of its kind can be carried and this last court affirms the judgment of the trial court, the case is finally determined.

**Examination of Witnesses.** When a witness is called to testify the examination is called direct examination. During this procedure, the questions asked are intended to bring out those facts which are in issue. A witness may testify as to fact when he has a recollection of his observation or when he has an im-

pression of it or a belief of it. As a general rule, leading questions are not permitted on direct examination. Leading questions are those which are so framed as to openly suggest to the witness the desired answer or to prevent him from telling the story in his own words by calling for the monosyllabic answer of "yes" or "no."

After a witness has testified in direct examination, the adverse party has a right to examine him with a view to discrediting his testimony. The process of testing the story and the credibility of the witness are known as cross-examination. Subject to certain limitations the credibility of a witness may be attacked on his own cross-examination or by independent testimony offered by other witnesses.

**Evidence.** Evidence consists of the testimony of witnesses who know something about the facts in the case. Written documents and papers and objects pertaining to the case are also admitted as evidence. In order to procure the attendance of the witnesses at the trial, the court issues an order, called a *subpoena*. Refusal to appear or to testify when called as a witness is *contempt of court*. Evidence must be competent, material, and relevant in order to be admissible in court.

The law does not require that to be proven which is apparent to the court. The process by which the court dispenses with proof of facts of common or general knowledge is called *judicial notice*.

**Best Evidence Rule.** When the contents of a written instrument are offered as proof, the law requires that the party seeking to prove the contents produce the document itself as the best evidence. Where only the existence of the document is in issue, oral evidence may be introduced to prove such existence. The rule requiring such production when the contents of a writing are to be proven is technically known as the best evidence rule.

The best evidence rule applies only to the contents of writings in issue, such as a written contract on which suit is being brought. Those writings which merely recite the happenings of events, such as certificates, receipts, etc., do not come within the best evidence rule.

**Secondary Evidence.** When a writing is in issue but unavailable, secondary evidence of its contents may be offered. If the party seeking to offer secondary evidence was originally in control of the paper, he must show his good faith by proving, to



the satisfaction of the court, that he has exhausted all reasonable avenues of search. If a party seeks to introduce secondary evidence of a paper, which is in the custody of his adversary, he must serve on the attorney for the adversary or the adversary himself a notice to produce.

**Real Evidence.** Real evidence consists of physical objects which have value in proving a fact. Such items as material used on construction may be offered in evidence and exhibited to the jury.

**Direct Evidence.** Direct evidence goes to prove the existence of a fact without any inference or presumption.

**Circumstantial Evidence.** Circumstantial evidence does not prove the existence of a fact directly but gives rise to a logical inference that such a fact does exist. In making these inferences, the determination of the facts involves logic and human experience. While neither logic nor human experience is unerring in the arrival at a true conclusion, generally the result of this process is satisfactory.

**Hearsay Evidence.** Hearsay evidence consists in the testimony of a witness in which the oral or written statement of another is offered as evidence of the existence or non-existence of a fact in issue. Hearsay evidence is deemed unreliable and is therefore inadmissible because the person whose observation is repeated in court is not under oath or subject to the test of cross-examination.

The courts sometimes allow hearsay statements as proof of the facts contained therein when there is difficulty in procuring other satisfactory and direct proof of the facts involved. However, when such hearsay statements are received, certain collateral facts must be adduced to aid in guaranteeing the trustworthiness and veracity of the evidence. These collateral facts are the foundation for each hearsay exception and must be presented before any hearsay statement will be received in evidence.

**Admission.** An admission is any statement made, any act done, or any course of conduct pursued by which a party to the litigation has indicated a contrary attitude to the one which he is taking at trial. Such prior contrary attitude tends to throw suspicion on his claim at trial and is used as independent evidence against him.

**Res Gestae Statements.** A declaration which accompanies and explains some act in issue is admissible in evidence, when it appears to have been spontaneously made and photographic of the act. For example, a victim falling from a broken scaffold cries out: "The wood was rotten." Such a spontaneous utterance is termed a *res gestae* statement and is deemed trustworthy in that the declarant expresses what he observes under the excitement of the event and before time is had for deliberation and reflection.

**Parol Evidence Rule.** In general, the parol evidence rule excludes any verbal evidence which would tend to change the meaning of a written instrument. The written document is assumed to express the full intent of the parties concerned, and any evidence tending to change such expressed intent would defeat the purpose of the writing. The parol evidence rule applies only to writings which are intended to create legal rights, such as contracts, deeds, mortgages, etc.

Ambiguities may appear in a writing either patently or latently. A patent ambiguity is one which is apparent from the instrument itself. In some instances parol evidence of the surrounding facts is admissible to show the intent of the writer. A latent ambiguity is one which does not appear on the face of the writing but becomes apparent when an attempt is made to apply the terms of the writing. Parol evidence is admissible to discover the writer's intent but the proof must not change the writing. If the writing is so indefinite that proof of surrounding circumstances would only be speculative as to the writer's meaning, no parol evidence is admissible to explain the meaning.

When a writing is ambiguous, proof of custom or usage may be introduced to ascertain its meaning, provided that the parties concerned entered into the arrangement with knowledge, express or implied, of the custom or usage. Ambiguities in a written instrument will be construed most unfavorably against the one who prepared the document.

**Opinion Evidence.** The testimony of a witness as to the conclusions he has made in respect to facts which he has observed is called opinion evidence. This type of evidence is generally inadmissible because of the unknown reasoning powers of the witness. Consequently the ordinary witness is required to state the

facts which he observed, leaving to the court or jury the function of deducing the conclusions.

**Opinion Evidence of Expert Witnesses.** An expert witness is one who, by reason of his general superiority in a given field of knowledge, is qualified either to discover the existence of facts not readily discoverable by the average man or to draw special conclusions from the existence of usual facts which the average man by reason of his inexperience would be unable to draw.

An expert is permitted to give his opinions based either on his own observations or on an assumed state of facts presented to him. The cross-examiner is aware of the basis of the opinion and can cross-examine accordingly. An assumed state of fact is made in the form of a hypothetical question. In this question the witness is asked to assume the existence of facts which are in evidence as the basis of his conclusion. This is necessary so that the cross-examiner will be informed as to the foundation of the opinion of the witness. The hypothetical question should state each assumption of fact from which the conclusion is to be made.

**The Engineer as an Expert Witness.** Engineers are called upon to give expert evidence in many kinds of lawsuits, such as those concerned with the strength and stability of structures, failure of structures, damage to structures, land boundaries, and traffic accidents. In the settlement of claims under construction contracts opinions are usually required relative to the interpretation of plans and specifications, quality of materials and workmanship, quantities of work performed, standard customs and practice, adjustments in the contract price to cover conditions different from those originally contemplated, and like matters on which controversies frequently arise. The basic procedures in the preparation of expert testimony are quite similar, however, irrespective of the type of case.

Prior to his appearance in court, the engineer should carefully review all aspects of the controversy. He should examine all correspondence, plans, specifications, tests, and other technical records and make a careful inspection of the site. Based on this study, he should prepare a preliminary report to the attorney. The preliminary report should give his opinion together with the facts, calculations, tests, drawings, or other data on which his

opinion is based. He should also point out the probable technical arguments of attack by the opponents and otherwise assist the attorney in organizing the case. At this point, if he should feel that the case is ethically indefensible, he should not hesitate to say so and decline to testify. If on the other hand he is convinced that his client's case has merit and his testimony can benefit the case, he should proceed with the detailed preparation of his testimony.

On the witness stand the engineer will usually confine his testimony to the answers to questions asked by his attorney, but when desirable he may make a general statement on a particular subject. His testimony should be presented in a quiet, dignified manner in order to secure the confidence and good will of the court. He should always keep in mind the fact that his testimony must be understood by persons who are not trained technically, and therefore his statements must be made in simple non-technical language. He may make use of notes, calculations, drawings, and the like, and he may cite as the basis of his opinion the works of recognized authors of textbooks. He should carefully consider every question asked of him and avoid hasty answers, taking time to make certain that he understands fully what is intended. He has the right to request sufficient time to make any calculations or researches he considers necessary to arrive at an answer, even to the extent of asking for a recess of the court for that purpose when necessary. The witness should be particularly careful in answering hypothetical questions because they frequently are designed to be misleading to the expert and are usually pointed as to their significance in the controversy.

In addition to the giving of testimony, the expert witness is expected to advise his attorney during the examination of other witnesses and in the cross-examination of opposing witnesses. In this manner he may bring out points of weakness in the opponent's case or discredit the opposing witnesses. In suggesting questions to be asked of witnesses, he should be certain to furnish the correct answers so that his attorney will always know what to expect in reply. Otherwise, he may inadvertently introduce testimony into the case which the attorney would prefer to have omitted. The suggesting of appropriate questions to the attorney should be particularly helpful in attacking the testimony of opposing experts.

### Questions

1. Define common law; statute law.
2. What are the essential elements of a valid contract? Are they required by common law or statute law?
3. Can the terms of a contract between two parties be enforced against a third?
4. What is meant by the expression "Ignorance of the law excuses no one"?
5. What types of mistakes may void a contract?
6. Give an example of unreason of consent.
7. Give an example of unlawful subject matter.
8. What is meant by an implied contract? an express contract?
9. What precautions should be observed when entering into a contract with a government agency?
10. What types of contracts are required to be in writing under the Statute of Frauds?
11. What precautions should be observed when entering into a contract with a partnership? a corporation?
12. What is the significance of the use of a seal in connection with contracts?
13. What is meant by "a real consideration"?
14. What happens when one of the parties dies before the completion of a contract?
15. What types of contracts may not be assigned?
16. How may a contract be changed?
17. Explain the meaning of the expression "Time is of the essence of the contract."
18. What is the difference between a penalty and liquidated damages?
19. What are the methods of terminating a contract? Explain.
20. Define and classify torts.
21. How may a tort be discharged?
22. Distinguish between a court of law and a court of equity.
23. Give three common types of controversies in engineering and construction work which are governed by the laws of equity.
24. Distinguish between a sale, a contract to sell, and a contract for labor and materials.
25. What is the significance of the expression "Caveat emptor"?
26. In the case of a sale, what are the responsibilities of the seller? of the buyer?
27. Define an agent. What qualifications must one have in order to become the agent of another person?
28. Discuss the authority and responsibilities of an agent.
29. Distinguish between an agent and an independent contractor.
30. Under what conditions may a principal be held responsible for the acts of an independent contractor? Under what conditions may the engineer as an agent of the owner be held responsible for his own acts?

31. What is meant by contingent liability?
32. Name four laws pertaining to the relationships between employer and employee which are of great importance in construction work.
33. What is a mechanic's lien?
34. What precautions should be observed during construction work to protect the owner against mechanic's liens?
35. Outline the system of courts in the United States.
36. What are the differences in court procedure for lawsuits arising out of private construction contracts as compared with those in connection with U.S. Government contracts?
37. Define the following terms.
  - a. Summons.
  - b. Plea.
  - c. Judgment.
  - d. Execution.
  - e. Levy.
  - f. Appeal.
  - g. Evidence.
  - h. Cross-examination.
38. Why is hearsay evidence considered unreliable?
39. What is an expert witness, and how does his testimony differ from ordinary opinion evidence?
40. Discuss expert testimony in professional engineering practice.
41. An employee of a grading contractor on a highway was injured through careless driving of a truck that was hauling gravel to the job from a pit. The gravel company's only connection with the work consisted in furnishing gravel to the grading contractor. The careless driver was the employee of the haulage contractor employed by the gravel company to deliver gravel to the job. The gravel company paid the haulage contractor so much per ton for hauling the gravel and merely designated where the material was to be delivered. All details as to loading, unloading, and movement of the trucks were under the control of the haulage contractor. Was the grading contractor, the gravel contractor, or the haulage contractor liable for the accident?

# 3

## TYPES OF CONSTRUCTION CONTRACTS

Like all types of contracts, those for engineering construction may be written in any one of many different forms, varying from a simple "offer and acceptance" to lengthy legal documents setting forth all the details and technicalities of the work. However, standardization of practice is desirable in the interests of economy of construction and satisfactory completion of the work. In recent years, a great deal has been accomplished along this line by professional societies, trade organizations, and various government agencies. As a result of the studies of these organizations the general form and content of construction contracts are fairly well established for the conditions most likely to arise.

Construction contracts may be classified in two general types, namely, competitive-bid contracts and those that are negotiated with selected contractors. Competitive-bid contracts are usually drawn on a fixed price basis whereas negotiated contracts usually provide for the owner to pay the actual cost of the work plus compensation to the contractor to cover his overhead expense and profit. Each type is designed to meet the requirements of particular conditions, and, since there are variations within each classification, it is necessary that they be clearly understood by the engineer.

**Competitive-Bid Contracts.** For public works construction all who are so inclined may submit a bid, and the contract will be awarded to the lowest responsible bidder. This is required by law in the case of U.S. Government work, and most state and local governments have similar restrictions. Responsibility in this sense usually means that the bidder must have ample working capital, as far as it can be determined at the time; that he can furnish the required sureties and guarantees; and that his record is free from defaulted contracts and unjustified litigation. Some evidence of previous experience is desirable but is not always required under existing laws. Private construction may be

handled in a more informal manner in that the list of bidders may be selected by the owner or recommended by the engineer, and the contract may be awarded to other than the lowest bidder if this appears to be in the best interests of the owner.

Competitive-bid contracts are of two common types. The *lump-sum* form provides for the compensation of the contractor on the basis of a total amount to cover all work and services required by the plans and specifications. The *unit-price* contract includes a breakdown estimate of the number of units of each type of construction and a price for each unit. Inasmuch as the estimate of quantities usually will not be exact at the time the contract is executed, provision should be made for payment to the contractor on the basis of actual quantities, measured in place when the work is completed, at the unit prices specified in the contract. For the purpose of comparing bids, an approximate total cost is determined from the estimated quantities and the unit prices in the bid. This approximate total cost is considered as a lump sum in the determination of the low bidder. With the exception of the method of payment to the contractor, the wording of the lump-sum and unit-price contracts may be similar. Important differences are found, however, in the methods of bidding and accomplishing the work under the two types and also in the wording of the specifications.

**Lump-Sum Contracts.** The use of the lump-sum contract is indicated where the types of construction are largely standardized and where a variety of operations is required, making it impracticable to break down the work into units. An important percentage of all building construction is accomplished under this form of contract. As a prerequisite the plans and specifications should be comprehensive and should show in complete detail the requirements of the work. Changes and extra work orders after the contract is signed are expensive and lead to controversies and disputes. Furthermore, when the plans are indefinite, the contractor is forced to gamble on the uncertainties or to increase his bid to cover the worst conditions to be expected. Consequently high costs to the owner will result if complete information is not furnished. If these hazards are avoided, the owner has the advantage of knowing in advance the exact cost of the work and of having the assurance that the contract will be completed at the



earliest practicable date since speed in completion will usually tend to increase the contractor's profit.

**Unit-Price Contracts.** When the work requires large quantities of a relatively few types of construction and the volume of work cannot be exactly determined in advance, the unit-price contract has many advantages. It is elastic in that reasonable variations may be made in the amount of work to be done without formal change orders, as long as the changes are restricted to the bid items covered by the contract. The plans and specifications must be complete in that they must show the nature and details of the work, but its limits may be left more or less indefinite, the magnitude and scope of the work being indicated by the engineer's estimate. Under these conditions the contractor is not forced to gamble on uncertain conditions, such as depths of underground foundation work, for example, as he would under lump-sum contracts.

**Combined Lump-Sum and Unit-Price Contracts.** Frequently, it may be advisable to combine the significant features of lump-sum and unit-price bidding in one contract. In general, this will be indicated when the work includes items, the details of which may be defined and broken down into units but which are somewhat indefinite as to quantities. For work of this character, unit-price payment is advantageous. If the same project includes specialty items or structures involving a large number of types of construction, the requirements of which are exactly known and for which the contractor can prepare an accurate estimate and bid, payment on a lump-sum basis will be simpler for everyone concerned. Thus the contractor's bid will include lump-sum amounts for some items and estimated quantities with corresponding unit prices for others. The combined type is well suited for building construction, for instance. Exact foundation conditions, generally indeterminate until the excavation is well along, can be covered satisfactorily on a unit-price basis whereas the superstructure is well adapted to lump-sum bidding since it is more definitely planned.

**The Contract Documents.** The procedure for setting up a competitive-bid contract is rigidly defined by law for public works projects. The same procedure is recommended for privately sponsored projects although some of the formalities may be omitted. The prescribed procedure for both lump-sum and unit-

price contracts requires the preparation of the following documents.

*a. Advertisement, or notice to contractors*, which gives a brief description of the work and invites bids from contractors for the accomplishment of its construction.

*b. Instructions to bidders*, which furnish detailed information required for the preparation of the bid or proposal.

*c. Form of bid or proposal*. This document is desirable in order that all bids will be uniform and prepared on a common understanding.

*d. Contract*, the legal document, binding on the signing parties, which states the work to be done, the compensation for the contractor, the time of completion, and the other legal and business features of the project as a whole.

*e. Specifications*, which cover the engineering or technical requirements of the work and describe the details of construction.

*f. Plans*, which show the physical details of the work.

The contract documents, excepting drawings, may be typed, mimeographed, or printed, and it is standard practice to bind them all into one volume which, together with the plans for work, is available to contractors for bidding and construction purposes.

**Negotiated Contracts.** In contrast to competitive-bid contracts in which the award is the result of open competition among all who are interested, negotiated contracts are awarded to selected contractors after a study of the qualifications, previous experience, and facilities of one or more candidates. Since competitive bidding is required by law for public works projects, negotiated contracts are normally restricted to private construction where they have many advantages under certain conditions. During periods of national emergency or war, legal restrictions against negotiated government contracts are removed by special legislation in order that their advantages may be available for the construction of war facilities. This is done at the expense of open competition, which is against the spirit of government contracting practice, but of no permanent effect because, during such periods, the construction industry is required to work at full capacity, and competition is not a major consideration. At the end of the emergency normal procedures are restored.

The fact that a contract is negotiated has little bearing on its form. That is to say, lump-sum and unit-price contracts may be negotiated as readily as any other type designed particularly for the purpose. In general, however, negotiated contracts are based on the premise that the owner will pay the actual cost of the work plus some compensation for the services, facilities, and technical knowledge of the contractor. It is only in the provision for the contractor's compensation that the various types differ materially. This arrangement places the contractor more or less on a professional basis where he represents the owner in matters relating to the work. Under these conditions, the contractor's compensation naturally is of the nature of a professional fee rather than the profit anticipated in a business transaction. Except for the payment provision, the content of all types of cost-plus contracts may be similar.

**Cost of the Work.** Under the common forms of negotiated contracts, the contractor furnishes the working capital required to finance the construction. Later he is reimbursed in the full amount of the actual cost of the work plus his compensation. Therefore the terms of the contract must anticipate methods for the control of expenditures and for determining the actual cost. This is particularly true of certain items of the contractor's overhead and indirect general expenses in his central office. These are difficult to determine exactly, and an agreement as to some approximate method for their distribution should be made. As an alternative, they may be eliminated altogether as items of cost, and the contractor's compensation may be increased a reasonable amount to cover them. This would be a matter for negotiation and is probably the most satisfactory method for handling the problem.

In order to control expenditures, provision should be made for the engineer to approve all payrolls and purchases prior to the placing of orders. Salaries of key men and executives should also be subject to approval. Wage rates will be those prevailing in the community. The determination of the actual cost of the work can be made only through an adequate cost accounting system, and the accounting methods of the contractor should be subject to the approval of the owner or the engineer.

**Cost-Plus-a-Percentage-of-Cost Contracts.** Undoubtedly the oldest form of the negotiated type of contract is that provid-

ing for the contractor's profit on the basis of a fixed percentage of the actual cost of the work. In common with all negotiated contracts this type permits the beginning of construction before the plans are completely developed, resulting in an important saving of time in the completion of urgent projects, and the owner may make any desired changes in the plans and specifications as the work progresses. It has the disadvantage to the owner that the contractor's compensation is increased by an increase in construction cost. Therefore, there is no incentive for the contractor to economize during construction. Indeed an unscrupulous contractor may deliberately inflate the construction cost in order to obtain the corresponding increase in his pay. This may be done by padding payrolls, taking commissions on material purchases, and the like. For these reasons, the cost-plus-a-percentage contract has been outlawed by the U.S. Government even during war and other emergencies. It is not recommended for general use, although extra work and change orders may sometimes be handled satisfactorily on this basis.

**Cost-Plus-a-Fixed-Fee Contracts.** This type of contract provides for payment to the contractor of the cost of the work plus a fixed amount as a fee for the accomplishment of the work. The amount of the fee is determined from a consideration of the character of the work and its estimated cost. Thereafter the fee remains fixed although the actual cost of the work may vary considerably from the estimate. In order to negotiate such a contract it is necessary for the scope of the work to be clearly defined and for both parties to agree on the amount of the estimate. This type had wide usage on government work during the war emergency and has also been used extensively in the construction of large, privately owned buildings for which accurate bidding estimates are difficult to prepare.

From the point of view of the relationship between the owner, the engineer, and the contractor, the cost-plus-a-fixed-fee contract more nearly approaches the ideal construction contract than any yet devised. The contractor is selected on the basis of merit and paid a fixed amount for completing specified work. There is no incentive for him to inflate the construction cost since his fee would not be affected. Indeed his profit might be decreased thereby, depending on the provisions for reimbursement of his overhead costs, because overhead costs vary almost directly with

construction costs. Therefore the contractor is free in every respect to act in the best interests of the owner.

**The Cost-Plus-a-Fixed-Fee Contract with a Profit-Sharing Clause.** As an added incentive to the contractor to keep the cost of the work at a minimum, a profit-sharing clause is sometimes written into the cost-plus-a-fixed-fee contract. Ordinarily the amount of the fixed fee is based on a preliminary estimate of the cost of the work. The profit-sharing provision allows the contractor to receive a share of any saving if the actual cost should be less than the original estimate. The contractor's share is usually set at 25 per cent to 50 per cent of the amount saved and is in addition to the fixed fee.

**The Cost-Plus-a-Fixed-Fee Contract with a Bonus Clause.** When the completion of the work is urgently desired by the owner, a bonus provision may be written into the contract as an incentive to the contractor to reduce the time of construction to a minimum. This is usually in the form of a fixed amount to be paid to the contractor, in addition to his fee, for each day on which the owner has full use of the completed work before the originally estimated date of completion. The contract may also provide for the assessing a fixed amount as liquidated damages against the contractor for each day after the originally estimated date of completion required by the contractor to finish the work.

**Contracts Based on Cost Plus a Sliding Scale of Fees.** Another variant of the cost-plus-a-fixed-fee type of contract which has been widely used for construction work provides for the contractor's fee to change proportionately to the actual cost of the work in accordance with a sliding scale of fixed fees. As in the profit-sharing type this may be used as an incentive to the contractor to reduce the cost of the work by allowing the fee to be increased in fixed amounts for various increments of cost less than the original estimate and decreased in fixed amounts for various increments of cost greater than the original estimate. In the latter case it is customary to arrive at a minimum fee which would remain unchanged with further increases in the cost of the work, thus guaranteeing a minimum profit to the contractor.

This type of contract also may be considered a compromise between the cost-plus-a-fixed-fee and cost-plus-a-percentage forms by allowing the contractor's compensation to increase with the cost of the work in accordance with the desired sliding scale rates

for various increments of cost in lieu of a constant percentage of the cost.

**The Cost-Plus Contract with a Guaranteed Ceiling Price.** One of the principal arguments against cost-plus types of contracts is that the owner has no way of knowing in advance what the work will cost. This objection may be overcome to a considerable degree by placing a maximum limit on the cost of the work. That is to say the contractor is reimbursed for the actual cost of the work plus his fee, provided that the total amount does not exceed the maximum limit established in the contract. If the total amount should exceed the maximum limit the contractor is held responsible for the excess and receives no compensation over the guaranteed ceiling price. This type of contract removes some of the uncertainties from the ordinary cost-plus contract but requires that the plans and specifications for the work be sufficiently developed to permit the establishment of a reasonable ceiling price.

**Management Contracts.** Negotiated contracts may anticipate that the contractor's forces, equipment, and personnel will be utilized on the work in the normal manner expected for general contract work, or the contractor may be retained in a managerial capacity only. In the latter case the entire work is supervised by the contractor, including the purchase of materials, hiring of labor, and letting of subcontracts. He may or may not elect to do parts of the work with his own forces. If management services only are intended, it should be so stated in the contract.

Management agreements are not to be confused with so-called brokerage contracts in which the contractor without the owner's prior knowledge enters into a contract with the intention of accomplishing all or most of the work by subcontracts with the view of collecting a profit on the work of each subcontractor. These are regarded with disfavor and should not be permitted. Management contractors, to the contrary, are selected on a professional basis for their honesty, technical skill, and administrative ability. Distinction also should be made between management and agency in this connection. Under an agency stipulation the owner is legally bound by the acts of the contractor whereas the acts of an independent contractor in connection with the work are his own responsibility. The owner does not assume re-

sponsibility for the work until it is completed and formally accepted.

**Architect-Engineer-Management Contracts.** A form of contract whereby all planning, designing, and management phases of construction work are delegated to one firm of architects and engineers was developed and used by the U.S. Government during World War II. This type had its widest use in the construction of military and industrial installations involving both architectural and engineering construction required in connection with the war effort. Responsibility is placed upon the contract architect-engineer-manager for all designs, plans, and specifications, the award of all construction subcontracts, and the inspection and management of construction work. This form of contract is usually drawn on a cost-plus-fixed-fee basis and differs from the usual owner-engineer-contractor relationship in that the architect-engineer-manager is placed in the status of an independent contractor whereas ordinarily he would be an agent of the owner. Also, all construction work under this type of agreement is accomplished by subcontracts between the architect-engineer-manager and the construction contractor rather than by prime contracts between the owner and the construction contractor. The architect-engineer-management contract has the advantage during a war emergency of delegating all matters pertaining to planning and construction to a single organization properly equipped and staffed to carry through all details of the project at a time when limited personnel and an overwhelming volume of work prevent the expeditious handling of the owner's responsibilities by his own organization. When drawn on a cost-plus basis it does not differ materially in effect from the ordinary cost-plus contract for engineering and architectural services for both design and supervision of construction. Any other basis, however, would place the architect-engineer in the position of a construction contractor.

**Combined Engineering and Construction Contracts.** It sometimes happens that the owner contemplating a construction project desires to deal with only one party for all services, both engineering and construction, in connection with the work; this is a so-called "turn-key" or "package" job. This procedure is, in fact, standard practice in most European and South American countries. A few United States companies also operate in this

manner. The contract may be drawn either on a firm price or cost-plus basis, and all planning, design, plans, specifications, and construction services are included under one contract. Combined engineering and construction contracts are contrary to professional engineering practice in the United States and are not ordinarily recommended. Traditionally the engineer is an agent of the owner. In his professional status he inspects and supervises construction work and acts to safeguard the owner's interests during construction. Also, he acts as an interpreter of the plans and specifications and as an arbitrator of disputes between the owner and the contractor. Under a combined engineering and construction contract the engineer is automatically placed in partnership with the contractor, and an objective professional viewpoint towards the owner's interests is impracticable. Many years of experience in the United States have proved that the owner's interests are best served both in economy and quality of construction work when the engineer's professional status is recognized and his services engaged through a direct independent agreement with the owner.

When a combined engineering and construction contract is indicated, either because of the owner's preference or by the customs of the country in which the work is to be performed, the engineer should have it clearly understood that he will be guided by the principles of engineering practice and professional ethics in carrying out his duties under the contract. This should be done irrespective of whether he expects to work as a co-venturer or as an employee of the contractor.

**Selection of Type of Contract.** Though the selection of the contract form is, strictly speaking, a function of the owner, it usually devolves on the engineer to furnish recommendations on which the owner may base his decision. In making a decision the fundamental differences between competitive-bid and negotiated contracts should be clearly understood and kept constantly in mind. A competitive-bid contract is a straightforward business transaction in which the owner takes his chances in an open market. He agrees to pay a specific price for a definite service, and constant inspection and supervision are required to make certain that the service is completed in the manner prescribed in the contract. In contrast, under the usual types of negotiated contracts the owner and the contractor are partners with a common



objective, namely, to complete the work in accordance with the owner's requirements as quickly and as economically as possible. In this case emphasis is on the control of expenditures, which are reimbursable to the contractor, rather than on inspection and supervision of his workmanship.

It will be advantageous to the owner to adopt a competitive-bid contract when sufficient time is available to work out the plans and specifications in detail, thus minimizing costly changes and extra work orders at a later date; when activity in the construction industry is at a low ebb, thus insuring keen competition and lower bids; and when some control can be exercised on the quality and character of the bidders.

A negotiated contract will be indicated when it is desirable to begin work before the completion of detail plans and specifications, thus assuring earlier completion of the work; when the requirements of the project cannot be determined definitely in advance of the early phases of construction; or when the nature of the project is such that an accurate estimate cannot be made for bidding purposes.

When a decision has been made between a competitive-bid and a negotiated contract, an analysis of the unique features of the project will usually indicate the most suitable variation to adopt. This selection will be as significant as that determining the general type.

When a competitive-bid contract is selected, a decision must be made between the lump-sum and unit-price types. This will be based upon the type of construction involved. In general, the lump-sum contract is used for building construction, equipment, and machinery. The unit-price form is used for most kinds of engineering construction, such as bridges, dams, highways, foundations, and the like. Local conditions may lead to exceptions to these rules, however.

When the owner decides upon the use of a negotiated contract with a selected contractor, the choice of the type of contract will usually be restricted to one of the variations of the cost-plus-a-fixed-fee form, in view of the disfavor in which the cost-plus-a-percentage type is held by most engineers. The particular variant to be adopted will depend on local conditions or personal preference. It should be noted however that practically all these variations introduce additional speculative elements into the con-

tract as compared with the straightforward fixed-fee basis and in most instances complicate the payment provisions of the contract unnecessarily. It is also noted that a contract may be negotiated on a lump-sum or unit-price basis as well as on a cost-plus basis. Ordinarily, however, this would require relatively complete plans and specifications, and in most instances it would be to the owner's advantage to obtain competitive bids.

**Subcontracts.** Generally all subcontracts for specialized phases of construction work are awarded on a competitive-bid basis irrespective of the type of the prime contract although some general contractors deal with favored subcontractors on a negotiated basis. Subcontracts may be of the lump-sum type, the unit-price type, or a combination of the two types as in the case of competitive-bid prime contracts. Subcontracts are the responsibility of the prime contractor, and the basis on which they are drawn is of no concern to the engineer and the owner under competitive-bid prime contracts, except that all subcontracts are subject to approval by the engineer. Under cost-plus prime contracts, however, all subcontracts are items of reimbursable cost, and therefore their amounts and terms should be closely scrutinized. Under these conditions negotiated cost-plus subcontracts should not be permitted, and usually a minimum of three competitive bids should be required in connection with all subcontracts to make certain that the cost of the work is kept to a minimum.

**Renegotiation of Contracts and Subcontracts.** During World War II a congressional act provided for the renegotiation of any contract or subcontract on government war projects amounting to more than \$100,000 to determine whether the profits or costs were excessive. If found to be excessive the contractor was required to return the excess to the government. Renegotiation proceedings were held before a board of experts and were initiated at the request of the government. When renegotiation was initiated in connection with one war contract, costs and profits under all contracts between that contractor and other government agencies were considered in combination, and the total profits from all work were considered in arriving at the amount of the excess. This procedure is contrary to the principles of contract law in which the court does not pass on the sufficiency of a bargain. However, it was enforceable during the emergency on

the grounds that no one should be allowed to profit excessively because of the war. This law was restricted to war contracts and does not apply in normal practice.

**Equipment Rental Contracts.** In addition to the foregoing, which are contracts for services, contracts for the rental of construction equipment are frequently necessary in the course of many construction projects. This type of agreement is required when the contractor lacks equipment necessary to the accomplishment of the work. Under cost-plus types of prime contracts the terms of equipment rental contracts are a direct concern of the owner. Otherwise the matter is restricted to the relationships between the contractor and the renter of the equipment, and the owner is not involved. Construction equipment may be rented on the basis of a lump sum for the duration of the job, a fixed rate per day or per hour, or on the basis of actual cost of ownership plus a predetermined profit for the owner of the equipment. The agreement may or may not include all operation costs and all personnel required in its use. Frequently a recapture clause is included whereby the renter may take over ownership of the equipment when the total rental reaches a specified amount or in case of a breach of the contract.

### Questions

1. What are the advantages and disadvantages of competitive-bid contracts?
2. Explain the difference between the methods of payment under lump-sum and unit-price contracts.
3. The following projects are to be constructed under competitive-bid contracts. Make a selection between the lump-sum and unit-price types, and give the reasons for each choice.
  - a. A sewer system.
  - b. A small residence.
  - c. A masonry dam.
  - d. A steel bridge superstructure.
  - e. A steam turbine.
  - f. The foundations for a large building.
4. When would it be advisable to use a combination of the lump-sum and unit-price methods of payment?
5. What is the main criticism of the cost-plus-a-percentage contract?
6. Why is the cost-plus-a-fixed-fee type considered the most satisfactory form of negotiated contract?
7. What are the advantages of the cost-plus-a-sliding-scale-of-fees type of negotiated contract?

8. Under what conditions would the cost-plus-type contract be indicated in lieu of the competitive-bid form?

9. What are the objections to a contract for combined engineering and construction services?

10. Why should subcontracts always be awarded on the basis of competitive bids when the prime contract is of a cost-plus type?

# 4

## BIDDING PROCEDURE

Of the documents required for competitive-bid contracts, three are related to the preparation of the bid. The *advertisement* invites bids or notifies contractors that bids are to be received. The *instructions to bidders* contain detailed information as to the various factors to be considered in arriving at the amount of the bid or the unit prices, as the case may be. The *bid*, or *proposal*, form prescribes the method to be followed in preparing the bid for submission. For public works these will be formal documents. For relatively unimportant private work the opposite extreme of informality would exist, and the necessary functions might be performed by letters or even telephone conversations. Nevertheless, in one form or another these three documents are required in connection with the award of any competitive-bid contract.

**U.S. Government Requirements Relative to the Advertising and Opening of Bids.** Before any contract with the U.S. Government for construction work can be awarded, it is required by law that the date for taking of bids be advertised and that bids be accepted from any qualified bidder who desires to bid on the work. During emergencies, such as a war, government contracting officers are permitted to negotiate directly with contractors without the formality of advertising. Under all normal conditions, however, the advertisement is required. State, county, and city public works are usually handled in a similar manner. The following federal statutes prescribe the procedure for the receiving of bids on government contracts.

*Advertisements for Proposals for Purchases and Contracts for Supplies or Services for Departments of Government.*

All purchases and contracts for supplies or services, in any of the departments of the Government, except for personal services, shall be made by advertising a sufficient time previously for proposals respecting the same, when the public exigencies do not

require the immediate delivery of the articles, or performance of the service. When immediate delivery or performance is required by the public exigency, the articles or services required may be procured by open purchase or contract, at the places and in the manner in which such articles are usually bought and sold, or such services engaged between individuals.

(Revised Statutes Section 3709.)

### *Opening Bids.*

Whenever proposals for supplies have been solicited, the parties responding to such solicitation shall be duly notified of the time and place of opening the bids, and be permitted to be present either in person or by attorney, and a record of each bid shall then and there be made.

(Revised Statutes Section 3710.)

**The Advertisement.** The purpose of the advertisement, or notice to contractors, is to inform prospective bidders that a contract is to be awarded and thus to obtain adequate competition for the work. The advertisement should be inserted in a newspaper or magazine which has a wide circulation, and it should be published sufficiently in advance of the date set for the opening of bids to allow contractors ample time to prepare their estimates, obtain prices and sub-bids for specialty work, and to make other arrangements necessary in arriving at the bid amounts. The time required to complete these operations will, of course, vary with the size and complexity of the project, but, ordinarily, three weeks should be considered about the minimum. When local competition is sufficient and satisfactory, the advertisement may be posted in a public place, such as a post office or city hall, or invitations to bid may be mailed to a number of contractors. The advertisement should be brief and written in a simple style.

The essential elements to be included are as follows.

a. Brief description of the work and its location. This should be written with the view of attracting the attention of only those interested and qualified to bid.

b. Name and address of the owner.

c. Name and address of person authorized to receive bids.

d. The place, date, and hour of the opening of bids and the restrictions relative to the submission, change, and withdrawal of bids.

*e.* Character of bids. This should state whether the bids are to be on a lump-sum or unit-price basis, and whether they are for the entire project or certain parts only. Note also should be made of any alternate bids requested.

*f.* Principal items of the work with approximate quantities involved. This informs the contractor immediately whether his equipment, organization, and experience are suitable for the work.

*g.* Bid surety. The amount of the surety and whether it is to be cash, a certified check, or a bid bond should be stated, as should be the provision for the return of the surety of unsuccessful bidders.

*h.* Contract surety. The amount and type of the performance and payment surety should be stated. If a certificate of surety is to be required with the bid, this also should be mentioned.

*i.* Conditions of payment. Required only if different from normal.

*j.* Information relative to the plans and specifications. It should be stated where the plans and specifications may be obtained or examined. This will usually be in the offices of the owner, the engineer, and sometimes in the offices of contractors' associations. Mention should also be made of any charge or deposit to be required for the plans and specifications when taken by contractors and provision for its recovery when the documents are returned.

*k.* Conditions of award of contract. Such as the reservation to accept the lowest responsible bid and to reject any or all bids.

*l.* Name of the engineer and the owner or their authorized representatives. In the latter case, the authorization should be stated.

### EXAMPLES OF ADVERTISEMENTS

UNITED STATES DEPARTMENT OF THE INTERIOR, Bureau of Reclamation, Washington, D. C., July 15, 1943. Sealed bids (Specifications No. 1056) will be received at the office of the Bureau of Reclamation, Redding, California, until 10 A.M., August 16, 1943, and then publicly opened for furnishing labor and materials and performing all work for the CONSTRUCTION OF A 230-KILOVOLT TRANSMISSION LINE from Shasta power plant to Oroville Kennett Division, Central Valley project, California. The transmission line will be a 230,000-volt, single-circuit, 60-cycle, wood-pole, H-frame-type transmission line approximately 100 miles long. The conductors will be 795,000 circular mil aluminum conductors, steel-reinforced (A.C.S.R.) having an outside

diameter of 1.108 inches and will be strung with a ruling span of 700 feet. Six transpositions will be constructed in the line. Each pole of two-pole structures shall be provided with a galvanized steel-strand ground wire stapled to the face of the pole continued under the butt of the pole, and then wrapped not less than five times around the base of the pole. This invitation for bids does not cover the purchase of materials which are to be furnished by the Government. Materials to be furnished by the contractor and those furnished by the Government are described in the specifications which will be a part of the contract. The work shall be commenced within fifteen (15) calendar days after date of receipt of notice to proceed and shall be completed within one hundred and ten (110) calendar days from the date of receipt of such notice. Guarantee will be required with each bid in an amount not less than 10 percent of the bid. Performance bond will be required in an amount not less than 50 percent of the estimated aggregate payments to be made under the contract. Payment bond will be required in the sum of one-half of the total amount payable by the terms of the contract. Liquidated damages for delay will be one hundred dollars (\$100) per day. Partial payments will be made monthly. No charge to prospective bidders for copies of the specifications and drawings; to others, \$2.50 per copy, not returnable. For particulars, address the Bureau of Reclamation, Redding, California; Denver 2, Colorado; or Washington 25, D. C., H. W. Bashore, Acting Commissioner.

EARTHEN DAM AND APPURTENANCES  
BEAVER WATER SUPPLY  
BEAVER, VIRGINIA

Sealed bids will be received by the Beaver Board of Water Supply up to 10:00 A.M., Wednesday, August 18, 1944, at their office, 3051 Idaho Ave., for furnishing certain materials and constructing an earthen dam forming an impounding reservoir. Separate bids will be received upon three parts of the project as follows:

Section A Earthen dam to contain 575,000 cu. yds. more or less as measured in borrow pits and specified appurtenances.

Section D Cast iron pipe and fittings f.o.b. cars, Beaver, Va., to be used in the dam and to connect to proposed pumping station.

Section E Valves f.o.b. cars, Beaver, Va., to be used in connection with the pipe and fittings purchased under Section D.

All of the above work and materials shall be in accordance with plans and specifications on file at the office of the Board of Water Supply and at the office of the engineers where same may be examined by prospective bidders. One copy of plans and specifications may be secured by application to either of the two undersigned upon payment of three dollars (\$3.00) per copy.

The right is reserved to reject any or all bids or to waive any informality in any bid.

BOARD OF WATER SUPPLY  
Beaver, Virginia  
V. B. Foley, Gen. Manager

*Greer & Knapp, Engineers*  
726 Jackson Place,  
Washington, D. C.



**Instructions to Bidders.** The instructions to bidders, also known as information for bidders, is a document in which all bidders are furnished identical information on the unique features of the work and detailed instructions on the procedure to be followed in submitting bids. This is desirable in order that all bidders receive uniformly fair treatment and that all bids are prepared on a common basis. The information given is similar in character to that in the advertisement, but it is expanded in greater detail and stated more explicitly. In addition to the topics in the advertisement, the instructions to bidders should include the following.

*a.* Requirements as to bidder's experience record or prequalification data. These will be used in judging the bidder's ability to perform the work and may eliminate unqualified contractors.

*b.* Instructions relative to the procedure to be followed in writing and submitting the bid.

*c.* A list of the plans and specifications and a detailed estimate of quantities for unit-price contracts or an exact definition of the scope of the work if the contract is to be on a lump-sum basis.

*d.* Time of completion of the work. This statement should specify the date on which construction shall start and the number of calendar days to be allowed for its completion. It may be desirable to request estimates of the time of completion from bidders. These estimates may then become a consideration in the award of the contract.

*e.* Statement as to whether the bidder or the owner is to be responsible for the accuracy of the bidding information with particular reference to subsoil data, test borings, errors in the plans, and the like.

*f.* Details of any formalities required in the bid and provision for the rejection of any informalities or of the entire bid in which they are included.

*g.* Reference to the authority for the accomplishment of the work and any other legal considerations involved in the award of the contract.

*h.* Miscellaneous instructions relative to the unique features of the work.

*EXAMPLES OF INSTRUCTIONS TO BIDDERS*

U.S. Standard Form No. 22  
Approved by the Acting Secretary of the Treasury  
July 13, 1939

**INSTRUCTIONS TO BIDDERS****(CONSTRUCTION AND SUPPLIES)**

**1. Preparation of bids.** Unless otherwise directed in the invitation, bids shall be submitted in triplicate. Forms furnished, or copies thereof, shall be used, and strict compliance with the requirements of the invitation, these instructions, and the instructions printed on the forms is necessary. Special care should be exercised in the preparation of bids. Bidders must make their own estimates of the facilities and difficulties attending the performance of the proposed contract, including local conditions, uncertainty of weather, and all other contingencies. All designations and prices shall be fully and clearly set forth. Copies of the bids shall be identical. The proper blank spaces in the bid and guaranty forms shall be suitably filled in.

**2. Labor and material not to be furnished by the Government.** The Government will not furnish any labor, material, or supplies unless specifically provided for in the contract.

**3. Signature to bids.** Each bid must give the full business address of the bidder and be signed by him with his usual signature. Bids by partnerships must furnish the full names of all partners and must be signed with the partnership name by one of the members of the partnership or by an authorized representative, followed by the signature and designation of the person signing. Bids by corporations must be signed with the legal name of the corporation, followed by the name of the State of incorporation and by the signature and designation of the president, secretary, or other person authorized to bind it in the matter. The name of each person signing shall also be typed or printed below the signature. A bid by a person who affixes to his signature the word "president," "secretary," "agent," or other designation, without disclosing his principal, may be held to be the bid of the individual signing. When requested by the Government, satisfactory evidence of the authority of the officer signing in behalf of the corporation shall be furnished.

**4. Bids for all or part.** Where bids are not qualified by specific limitations, the Government reserves the right of awarding all or any of the items according to its best interests. Unless otherwise required in the specifications, bids for supplies shall be submitted in accordance with the numbered item or items given in the schedule.

**5. Alternative bids.** Alternative bids will not be considered unless called for.

**6. Specifications and schedules.** The specifications, conditions, schedules, and drawings which form the basis of any bid will be considered as a part thereof and will form a part of the contract. Copies of these papers, together with a copy of the standard contract form, including authorized additions or deletions, if any, will be furnished to or made available for the

inspection of bidders by the office indicated in the advertisement or invitation.

**7. Corrections.** Erasures or other changes in the bids must be explained or noted over the signature of the bidder.

**8. Guaranty.** Where security is required to insure the execution of contract and bond for performance of the service, no bid will be considered unless it is so guaranteed. The bidder, at his option, may furnish a guaranty bond or certified check, or may deposit, in accordance with Treasury Department regulations, bonds or notes of the United States (at par value) as security in the amount required: *Provided*, That where not in conflict with the law, the bidder may be limited to the option of furnishing a certified check or bonds or notes of the United States when the amount of the security does not exceed \$1,000, notice of such requirement to be given in the invitation to bidders.

In case security is in the form of a certified check or bonds or notes of the United States, the Government may make such disposition of the same as will accomplish the purpose for which submitted. Certified checks may be held uncollected at the bidder's risk. Certified checks, or the amount thereof, and bonds or notes of the United States deposited by unsuccessful bidders will be returned as soon as practicable after the opening.

**9. Bonds.** The bond of any surety company authorized by the Secretary of the Treasury to do business, or of two responsible individual sureties, will be accepted as security for any bid or contract. See the instructions at the end of the applicable standard form bond with respect to the qualifications and sufficiency of sureties and the manner in which bonds should be executed.

**10. Marketing and mailing bids.** Bids, with their guaranties, must be securely sealed in suitable envelopes, addressed and marked on the outside as required by the invitation.

**11. Time for receiving bids.** Bids received prior to the time of opening will be securely kept, unopened. The officer whose duty it is to open them will decide when the specified time has arrived, and no bid received thereafter will be considered, except that when a bid arrives by mail after the time fixed for opening, but before award is made, and it is shown to the satisfaction of the officer authorized to make the award that the nonarrival on time was due solely to delay in the mails for which the bidder was not responsible, such bid will be received and considered. No responsibility will attach to an officer for the premature opening of a bid not properly addressed and identified. Unless specifically authorized, telegraphic bids will not be considered, but modifications by telegraph of bids already submitted will be considered if received prior to the hour set for opening.

**12. Withdrawal of bids.** Bids may be withdrawn on written or telegraphic request received from bidders prior to the time fixed for opening. Negligence on the part of the bidder in preparing the bid confers no right for the withdrawal of the bid after it has been opened.

**13. Bidders present.** At the time fixed for the opening of bids, their contents will be made public for the information of bidders and others properly interested, who may be present either in person or by representative.

**14. Award or rejection of bids.** The contract will be awarded to the lowest responsible bidder complying with conditions of the invitation for bids, provided his bid is reasonable and it is to the interest of the United

States to accept it. The bidder to whom the award is made will be notified at the earliest possible date. The United States, however, reserves the right to reject any and all bids and to waive any informality in bids received whenever such rejection or waiver is in the interest of the United States. It also reserves the right to reject the bid of a bidder who has previously failed to perform properly or complete on time contracts of a similar nature, or a bid of a bidder who is not in a position to perform the contract.

**15. Time of performance.** When not otherwise specified, the bidder must state the least number of calendar days (counting Sundays and holidays) after date of receipt of notice to proceed, in which he will commence performance and the number of calendar days (counting Sundays and holidays) after the date of receipt of notice to proceed in which he will complete. In stating time the bidder should make due allowance for probable difficulties which may be encountered.

**16. Bidders interested in more than one bid.** If more than one bid be offered by any one party, by or in the name of his or their clerk, partner, or other person, all such bids may be rejected. This shall not prevent a bidder from submitting alternative bids when called for, nor from quoting different prices on different qualities of material or different conditions of delivery. A party who has quoted prices on materials to a bidder is not thereby disqualified from quoting prices to other bidders or from submitting a bid directly for the materials or work.

**17. Errors in bid.** Bidders or their authorized agents are expected to examine the maps, drawings, specifications, circulars, schedule, and all other instructions pertaining to the work, which will be open to their inspection. Failure to do so will be at the bidder's own risk, and he cannot secure relief on the plea of error in the bid. In case of error in the extension of prices the unit price will govern.

**18. Dealer or manufacturer.** In bids for supplies or manufactured articles, bidders will state whether they are manufacturers of or regular dealers in the articles. If practicable to do so, bidders who are not manufacturers will give the name of the manufacturer from whom the articles are to be obtained, including catalog references.

**19. Samples.** When samples are required, they must be submitted by the bidder so as to reach the office designated prior to the hour set for opening the bids. Samples shall be furnished free of expense to the Government, properly marked for identification, and accompanied by a list when there is more than one sample. The Government reserves the right to mutilate or destroy any sample submitted whenever it may be considered necessary to do so for the purpose of testing. Samples not so mutilated or destroyed, when no longer required to be retained in connection with the award or delivery of supplies, will be returned, at the bidder's expense, if such return is requested in the bid.

**20. Contract and bond.** The bidder to whom award is made must, when required, enter into written contract on the standard Government form, with satisfactory security in the amount required, within the period specified or, if no period be specified, within 10 days after the prescribed forms are presented to him for signature.

[These instructions are not to be incorporated in the contract.]

**INFORMATION FOR BIDDERS \*****1. RECEIPT AND OPENING OF BIDS**

Sealed bids for the construction of the superstructure of the Rainbow Bridge over the Niagara River between Niagara Falls, New York, and Niagara Falls, Ontario, will be received by the Niagara Falls Bridge Commission at its office in Niagara Falls, New York, until 11 o'clock A.M. on March 20th, 1940, and then publicly opened and read aloud. Bids shall be made on the forms bound herewith, and shall be enclosed in a sealed envelope addressed to the Commission, and endorsed with the name of the bidder and the title "Bid for the Construction of the Superstructure of the Rainbow Bridge, Contracts No....."

Bids will be received on the basis of both concrete approach spans and steel approach spans, under the following contracts:

- Contract No. 3A, Superstructure of Arch Span,  
Concrete Approach Layout
- Contract No. 3B, Superstructure of Arch Span and Approach Spans,  
Steel Approach Layout
- Contract No. 4, Superstructure of Approach Spans on American Side,  
Concrete Approach Layout
- Contract No. 5, Superstructure of Approach Spans on Canadian Side,  
Concrete Approach Layout

Bidders may tender upon any or all contracts. The decision between the two types of approaches will be made by the Commission after the receipt of bids.

Attention is called to the fact that bidders not only offer to assume the obligations and liabilities imposed upon the Contractor in the Form of Contract, but expressly make certain of the representations and warranties made therein. No effort is made to emphasize any particular provision of the Contract, but bidders must familiarize themselves with every provision and its effect.

**2. PLANS AND SPECIFICATIONS**

Plans, Specifications, and Bidding and Contract Forms may be seen at the offices of Waddell & Hardesty, 142 Maiden Lane, New York, N. Y., Edward P. Lupfer Corporation, 594 Ellicott Square, Buffalo, N. Y., Hagey & Gray Engineering Company, Fort Erie, Ontario, and C. Ellison Kaumeyer, Secretary of the Bridge Commission, Administration Building, Niagara Parks Commission, Niagara Falls, Ontario. Copies of these papers may be secured at the said offices by the deposit of \$15.00 for each set, \$10.00 whereof will be refunded upon returning the set in good condition within one week after the award of the Contract.

**3. PREPARATION OF BIDS**

Bids must be made upon the prescribed forms. All blank places must be filled in as noted, in ink, in both words and figures, with amounts extended

\* Reproduced by permission of Waddell & Hardesty, Consulting Engineers, New York City.

and totaled, and no changes shall be made in the phraseology of the forms or in the items mentioned therein. In case of any discrepancy between the written amounts and the figures, the written amounts shall govern. Any bid may be deemed informal which contains any omissions, erasures, alterations, additions, irregularities of any kind, or items not called for, or which does not contain prices set opposite to each of the several items in the bid form, or in which any of the prices are obviously unbalanced, or which shall in any manner fail to conform to the conditions of the published notice inviting bids.

The bidder shall sign his bid in the blank space provided therefor. If the bid is made by a partnership or corporation, the name and address of the partnership or corporation shall be shown, together with the names and addresses of the partners or officers. If the bid is made by a partnership, it must be acknowledged by one of the partners; if made by a corporation, by one of the officers thereof.

Prices for Contracts No. 3A, 3B, and 4 shall be stated in United States money, and prices for Contract No. 5, in Canadian money.

#### 4. QUALIFICATIONS OF BIDDERS

The Commission may make such investigation as it deems necessary to determine the ability of the bidder to perform the work, and the bidder shall furnish to the Commission all such information and data for this purpose as the Commission may request, including also, if requested, a detailed list of the plant and equipment which the bidder proposes to use, indicating which portions he already possesses, and a detailed description of the method and program of work he proposes to follow. The Commission reserves the right to reject any bid if the evidence submitted by or investigation of such bidder fails to satisfy the Commission that such bidder is properly qualified to carry out the obligations of the Contract and to complete the work contemplated therein.

#### 5. BID SECURITY

Each bid must be accompanied by a deposit in an amount not less than fifteen (15) per centum of the amount of the gross sum named in the bid. In case a Contractor submits bids on both Contracts No. 3A and 3B, one deposit, based on the larger of the gross sums bid, will be sufficient, but separate checks will be required for Contracts No. 3A, 4, and 5. For Contracts No. 3A, 3B, and 4, such deposit shall consist of a certified check in United States money upon a state or national bank or trust company, drawn to the order of the Niagara Falls Bridge Commission; and for Contract No. 5, it shall consist of a similar certified check in Canadian money on a Canadian bank, which check may be deposited with C. Ellison Kaumeyer, Secretary of the Bridge Commission, Administration Building, Niagara Parks Commission, Niagara Falls, Ontario, at any time prior to the time named for the receipt of bids. Within three days after the formal opening of bids, such checks will be returned except those deposited by the three lowest formal bidders on each contract, which, with the exception of the check of the successful bidder on each contract, will be returned within three (3) days after the execution of the contract by the successful bidder and the Commission. The check of the successful bidder will be returned to him without interest when the value of the Work completed hereunder equals or exceeds twice the amount of the said check.

Should the successful bidder fail or refuse to execute and deliver the Contract and Bond required within seven (7) days after he has received notice of the acceptance of his bid, he shall forfeit to the Commission, as liquidated damages for such failure or refusal, the security deposited with his bid.

## 6. CONDITIONS OF WORK

Each bidder must inform himself fully of the conditions relating to the construction and labor under which the work is now being or will be performed, and will be presumed to have inspected the site and to have read and to be thoroughly familiar with the Plans and other Contract Documents. Failure so to do will not relieve a successful bidder of his obligation to furnish all material and labor necessary to carry out the provisions of the Contract Documents and to complete the contemplated work for the consideration set forth in his bid. Attention is called to the uncertainty in the quantities of many of the items involved in the Contract. Where borings are indicated on the Plans, it is understood that they were made in the usual manner and with reasonable care, and their location, depths, and the character of the material have been recorded in good faith. There is no expressed or implied agreement that the depths or the character of the material have been correctly indicated, and bidders should take into account the possibility that conditions affecting the work to be done may differ from those indicated.

Each bidder must inform himself regarding customs duties and sales taxes in connection with the work. Attention is called to the fact that, under Customs Tariff Item 460 of the Dominion of Canada and under the procedure of the Customs Service of the Treasury Department of the United States, provision is made for the duty-free entry from one country into the other of materials and equipment for the construction of the main span, when properly certified on the import entries; also that material classified under Customs Tariff Item 460, together with cement, sand, gravel, and certain steel used in the construction of the Canadian approach, are subject to exemption from the eight (8) per cent sales or consumption tax of the Dominion of Canada; but the bidder must determine for himself the application of such duty-free entries and exemptions to his work.

The bidder's attention is called to the fact that the Contractor will be required to pay workmen employed on this Contract at rates not less than the local prevailing rates of wages; to comply with other applicable provisions of labor laws; and to use, in his operations in either country, workmen who are residents of, and materials produced in, such country, except as otherwise provided in the Form of Contract and the Specifications.

## 7. ACCEPTANCE OF BID AND AWARD OF CONTRACT

Within thirty (30) days after the opening of the Bids, the Commission will accept one of the Bids or will act in accordance with Paragraph 11 of this "Information for Bidders." The acceptance of the Bid will be by notice in writing signed by the Chairman of the Commission, mailed to or delivered at the office designated in the Bid. If, within seven (7) days after the acceptance of his Bid, the successful bidder shall refuse or neglect to attend at the office of the Commission and to execute the Contract and furnish the required Contractor's Bond properly signed by the Contractor, and by a surety or sureties satisfactory to the Commission as hereinafter

provided, the bidder shall be deemed to be in default, and shall forfeit his deposit.

When the Contract has been executed on the part of the Commission, it shall be forwarded to the Contractor together with a notice from the Engineers to commence work. The Contractor shall begin operations within five (5) days after the date of such notice.

#### 8. ANALYSIS OF BID PRICES

The bidder to whom the Commission intends to award the Contract will be required to furnish the Commission, within twenty-four (24) hours of the request so to do, the analysis of bid prices quoted by him, for which provision is made in the clause of the Form of Contract entitled "Analysis of Bid Prices." Since no award of the Contract will be made until the said bidder has furnished said analysis, each bidder should, in his own interest, prepare such an analysis at the time of preparing his bid.

#### 9. SECURITY FOR FAITHFUL PERFORMANCE

Simultaneously with his delivery of the executed Contract, the successful bidder must deliver to the Commission an executed bond in the amount of one hundred per centum (100%) of the accepted bid as security for the faithful performance of his Contract and for the payment of all persons performing labor or furnishing materials in connection therewith, prepared on the form of Bond attached hereto and having as surety thereon such surety company or companies approved by the Commission and authorized to transact business in the State or Province where the Work is located as are acceptable on bonds given to the United States Government or the Province of Ontario.

If the Contractor is a partnership, the bond should be signed by each of the individuals who are partners; if a corporation, the bond should be signed in the correct corporate name by a duly authorized officer, agent, or attorney-in-fact. There should be executed an appropriate number of counterparts of the bond corresponding to the number or counterparts of the Contract. Each executed bond should be accompanied by (a) appropriate acknowledgments of the respective parties; (b) appropriate duly certified copy of Power of Attorney or other certificate of authority where bond is executed by agent, officer, or other representative of Contractor or Surety; (c) a duly certified extract from By-Laws or resolutions of Surety under which Power of Attorney or other certificate of authority of its agent, officer, or representative was issued, and (d) duly certified copy of latest published financial statement of assets and liabilities of Surety.

#### 10. TIME OF COMPLETION

The time of completion of the Work to be performed under this Contract is on or before August 1, 1941, or as more fully described under Article 10 of the Contract. In the event of failure to complete the Work within the time specified, liquidated damages will be assessed as provided in the Contract.

#### 11. RIGHT TO ACCEPT AND REJECT BIDS

The Commission reserves the unqualified right, in its sole and absolute discretion, to decide between the concrete and steel approach layouts, to reject any and all Bids, or to accept that Bid, or combination of Bids, if



any, which in its sole and absolute judgment will under all the circumstances best serve the public interests.

In the event that the successful bidder fails to execute the Contract upon his part or to furnish satisfactory surety upon the bond, the Commission, after declaring forfeited the security deposit of such bidder, reserves the option to accept the Bid of any other bidder within ten (10) days from such default, in which case such acceptance shall have the same effect as to such bidder as though he were the originally successful bidder.

**Responsibility for Accuracy of Bidding Information.** In many types of construction work the amounts of bids will depend on local conditions at the site some of which cannot be determined exactly in advance. This applies particularly to the construction of underground structures, such as foundations, sewers, water mains, and the like where the character of the subsoil determines the cost of the work. For the purposes of design, explorations are usually made by the owner by means of borings, test pits, test piles, and other methods, and information obtained in this manner is made available to bidders. At best, such tests cannot cover the entire site thoroughly. The information obtained thereby does not reveal all conditions, and sometimes it is misleading or subject to incorrect interpretation. This may have important effects on the actual cost of the work as compared with that anticipated in the bid, and the question then arises as to the responsibility for the discrepancy. Many lawsuits have originated from disputes caused in this way. Therefore, it is necessary that the contract documents state explicitly which party is to assume responsibility for the accuracy and interpretation of bidding information furnished by the owner.

Unless covered by a statement to the contrary, the owner will always be held responsible for the accuracy of information which he furnishes to bidders. The interpretation of such information is a risk that the owner, particularly in private work, usually should not assume on the grounds that the contractor is versed in such matters whereas the owner is not, and the risk is one of the normal hazards of the contracting business. Therefore, responsibility for the accuracy and interpretation of information furnished by the owner is usually placed on the contractor. It might be argued that the engineer is likewise familiar with such technical matters and should assume responsibility for their accuracy. It should be noted, however, that the engineer ordinarily acts as the agent of the owner, and his fee or salary usually does

not contemplate such risks whereas, when assumed by the contractor, it is considered that his bid will be adjusted adequately to insure himself against the most probable unfavorable conditions, consistent with the competitive nature of his business. In his agreement with the owner, the engineer should make certain that he does not inadvertently place himself in a position where he might be made responsible in questions of this kind.

It is usually sufficient in order to protect the owner in this connection to place on the drawings or in the specifications a statement that all such information (boring data, driving records, and load tests of test piles, etc.) is furnished to bidders as the best information available, to be interpreted and used as the bidder sees fit and on the bidder's own responsibility, and that the owner disclaims all responsibility for its accuracy and sufficiency. The bidder is usually made responsible for informing himself on the character of the site and for making any additional investigations necessary to assure himself of the nature of conditions to be encountered in the work.

An alternative procedure permits a readjustment of the contract amount if actual subsurface or latent conditions should differ materially from those indicated in the bidding data or those inherent in the type of work covered by the contract. U.S. Government agencies, in particular, favor this procedure, which in effect places the responsibility for the accuracy of bidding information on the owner. Its interpretation, however, remains the responsibility of the contractor. This method reduces the risk in the contractor's bid and should reduce construction costs as well. Moreover, the owner pays for the actual work performed whether more or less than that indicated in the bidding information, which is consistent with ethical business practice. This method has the disadvantage that contractors can almost always show some discrepancy between the actual conditions and those indicated in the bidding information, and controversies result. This may not be serious in the case of government contracts because of the great administrative and legal strength given to government contracting officers, but it may be a constant source of annoyance, embarrassment, and litigation on private work.

**Bid Form.** In order that all bids may be prepared in a similar manner the appropriate form should be prescribed. This is desirable to facilitate the analysis and comparison of bids and to

detect informalities, particularly in view of the fact that frequently large numbers of qualifications, reservations, and alternative bids may be included. Furthermore, the bid form is a convenience to contractors in that it tends to insure accuracy and prevent omissions. The bid form should contain the following elements.

*a.* Price for which the contractor offers to perform the specified work. If the contract is to be on a lump-sum basis, the price will be the total amount of the bid without a breakdown of quantities, or, if there is more than one bid item, a lump-sum amount will be given for each item. If a unit-price contract, there will be a list of the bid items, the engineer's estimate of the quantity of each item, and a unit price for each item. It should be noted that the quantities are approximate and may be varied during construction. All prices should be given in both words and figures, and if there are discrepancies, the amounts written out govern. In case of discrepancy between unit prices and the respective total for each item, unit prices govern.

*b.* Time of completion. This should state that the work will begin on a definite date, or within a specified number of days, after the receipt of a notice from the owner to proceed with the work. It should also be stated that the work will be completed within a specified number of calendar days after receipt of the notice to proceed.

*c.* Bid surety. It should be stated that a bid bond, certified check, or other form of guarantee accompanies the bid as required.

*d.* Agreement to furnish contract surety. By this statement the bidder agrees to furnish the required contract surety if the contract is awarded to him. The bidder is sometimes required to furnish a certificate of surety properly executed by the guarantor. This certifies that if the bidder is awarded the contract the guarantor will furnish the required surety.

*e.* List of addenda to the plans and specifications which were considered when the bid was prepared. Frequently changes are incorporated in the plans and specifications after the advertisement has been published, and prospective bidders are so notified by means of addenda. It is necessary to note the inclusion in the bid of such changes, particularly in the case of lump-sum contracts.

*f.* List of subcontractors. Under some conditions it may be desirable to require the bidder to specify the subcontractors to be employed on specialty work. This is usually not necessary if the contract provides for the approval of all subcontractors by the owner and the engineer prior to their employment.

*g.* Experience record, financial statement, and plant and equipment questionnaire, when required.

*h.* Declaration that no fraud or collusion exists, with particular reference to illegal relationships between the bidder and representatives of the owner, pooling of bids by several bidders, straw bids submitted by an employee or other representative of the bidder, and similar illegal acts.

*i.* Statement that the site has been examined and that the plans and specifications are understood by the bidder.

*j.* Signature and witnesses.

**Selection of Bid Items for Unit-Price Contracts.** The bid form for unit-price contracts contains a tabulation of the various items of work, the unit of measurement, and the estimated quantity of each item. In arriving at the items to be included the work is broken down into the basic types of construction, such as excavation, concrete, structural steel, and the like, each type and each classification of a type of construction comprising one bid item. This procedure necessarily conforms with the methods of estimating quantities and costs.

Each item of work must be capable of being measured accurately and must be such that all elements of its unit cost will vary in direct proportion with any changes in the total number of units. For example, the cost of one cubic yard of concrete consists of the sum of the costs of the various ingredients and the cost of mixing, placing, and curing. Within reasonable limits the magnitudes of these elements relative to each other remain approximately constant and independent of the number of cubic yards poured. Therefore, it is convenient to consider "concrete in place" as one bid item rather than to set up separate items for cement, sand, gravel, mixing, placing, etc. When the character of the concrete work is such that the relative amounts of form work and reinforcing steel are also constant throughout the various parts of the structure it would be convenient to consider "reinforced concrete in place" as one item. If the work includes

TABLE III

## TYPICAL ESTIMATING UNITS FOR UNIT-PRICE CONTRACTS

Clearing and grubbing	Acre
Excavation, various classes	Cubic yard
Piling	Linear foot
Fine grading	Square yard
Pavement	Square yard
Sidewalks	Square foot
Curb and gutter	Linear foot
Sewers, each diameter size	Linear foot for various intervals of depth *
Water mains, each diameter size	Linear foot for various intervals of depth *
Roofing	Square (10 ft. by 10 ft. = 100 sq. ft.)
Cement	Barrel (4 bags = 3.8 cu. ft.)
Sand and gravel	Cubic yard
Concrete, various classes	Cubic yard
Lumber	Thousand feet, board measure (M.B.M.)
Concrete forms	Square foot of contact surface
Brick, face and common	Thousand
Masonry, including mortar	Cubic yard
Plaster	Square foot
Reinforcing steel	Pound or ton
Structural steel	Pound or ton
Steel rail	Pound or ton
Metal castings	Pound (or piece)
Painting	Square (10 ft. by 10 ft. = 100 sq. ft.)
Motors, pumps, etc.	Each (lump sum)

\*An alternate method provides for trench excavation and backfill as separate items on a cubic-yard basis. When this is used, sewer and water pipe units include the cost of furnishing and placing each size of pipe exclusive of excavation and backfill.

heavy, massive, unreinforced concrete members requiring minimum form work in one part of the structure and thin heavily reinforced sections requiring expensive form work in another part, the form work and reinforcing steel should be made separate bid items. Likewise, each class of concrete mixture should be made a separate bid item. When practicable, work that may be performed by different trades or different subcontractors should be segregated into separate bid items. The list of bid items should be carefully examined and analyzed to make certain that all phases of the work are included in one item or another and that none of the items overlaps so that some element of the work is included more than once, resulting in duplication in payments.

Within the foregoing requirements it will be convenient to keep the number of bid items to a minimum. These are more or less standardized for the common types of construction and unless there are good reasons to the contrary it is usually advisable to conform with standard practice in this respect.

**Units for Measurement and Payment under Unit-Price Contracts.** The units to be adopted for bidding purposes and for measurement and payment under unit-price contracts conform closely with standard estimating practice. In general, units are made as large as practicable for accurate measurement with the provision that the unit adopted shall be a true measure of the cost of the work when the quantity varies.

When the plans and specifications for any portion of the work are complete in all details and no variation whatsoever in the quantities is contemplated, it will be convenient to adopt a lump sum as the bid unit for that portion of the work. Likewise, a lump sum may be used for such items as machinery, equipment, special castings, and the like.

Typical units for the common types of construction are shown in Table III.

*EXAMPLES OF BID FORMS*

U.S. Standard Form No. 21 (Revised)  
Approved by the Secretary of the Treasury  
April 5, 1937

Bid No. ....

**BID (Lump Sum)**

**(CONSTRUCTION CONTRACT)**

Date.....

To.....

.....

In compliance with your invitation for bids dated.....  
the undersigned hereby proposes to furnish the materials and perform the work for  
in strict accordance with the specifications, schedules, and drawings,  
for the consideration of

## BIDDING PROCEDURE

and agrees, upon receipt of written notice of the acceptance of this bid within 60 days after the date of opening of the bids (if no shorter period be specified), that he will (if the advertisement or accompanying papers provide therefor) execute U.S. Standard Form of Contract No. 23, in accordance with the bid as accepted, and give performance bond on U.S. Standard Form No. 25 and payment bond on U.S. Standard Form No. 25A, with good and sufficient surety or sureties, within 10 days (unless a longer period is allowed) after the prescribed forms are presented for signature.

The bidder further agrees that if awarded the contract he will commence the work within.....calendar days after the date of receipt of notice to proceed, and that he will complete the work within.....calendar days after the date of receipt of notice to proceed.

Enclosed is security as required, consisting of.....

By .....

(Business address)

*Note.* Read Standard Government Instructions to Bidders (Form No. 22) before preparing this bid, observing particularly paragraphs 3 and 8. If bidder is a corporation indicate State of incorporation under signatures; and if a partnership give full names of all partners. The numbering of the bid is optional with the Department concerned.

### BID (Unit Price) \*

#### FOR CONTRACT NO. 3A

TO THE NIAGARA FALLS BRIDGE COMMISSION:

FOR MATERIAL AND LABOR NECESSARY FOR THE CONSTRUCTION OF THE SUPERSTRUCTURE OF ARCH SPAN OF THE RAINBOW BRIDGE OVER THE NIAGARA RIVER, CONCRETE APPROACH LAYOUT.

The undersigned agrees to furnish all labor, materials, plant and other facilities, and to perform all work necessary or proper for or incidental to the construction of the work herein called for, complete in every respect, in strict accordance with the Plans and Specifications and any future changes made therein as provided in the Contract and Specifications, and to perform all other obligations and assume all liability imposed upon the Contractor by the Contract; and further agrees to accept in full compensation therefor the prices named in the following schedule and, except as otherwise provided in the Contract and Specifications, such prices only:

\* Reproduced by permission of Waddell & Hardesty, Consulting Engineers, New York City.

SCHEDULE OF PRICES—IN AMERICAN MONEY

Item No.	Approximate Quantities	Items with Unit Prices Written in Words	Unit Prices in Figures		Amounts	
			Dollars	Cents	Dollars	Cents
1	400	Cubic Yards of 12 3½ Concrete in Arch Abutments, for per cubic yard				
2	1,420	Cubic Yards of 11¾ 3½ Concrete in Slabs and Curbs on Arch Span, for per cubic yard				
3	200 000	Pounds of Bar Reinforcement for Structures, for per pound				
4	340 000	Pounds of Reinforcing Trusses for Roadway Slabs, for per pound				
5	2 440 000	Pounds of Structural Carbon Steel in Floorsystem of Arch Span, for per pound				
6	440 000	Pounds of Structural Silicon Steel in Floorsystem of Arch Span, for per pound				
7	1 140 000	Pounds of Structural Carbon Steel in Spindrel Columns of Arch Span, for per pound				
8	940 000	Pounds of Structural Carbon Steel in Rib Laterals, for per pound.				
9	6 150 000	Pounds of Structural Silicon Steel in Arch Ribs, for per pound				
10		Provision for Utilities, for the Lump-Sum Price of dollars				

Total or Gross Sum Bid Written in Words



## BIDDING PROCEDURE

It is understood that the approximate quantities shown in the foregoing Schedule are solely for the purpose of facilitating the comparison of Bids, and that the Contractor's compensation will be computed upon the basis of the actual quantities in the completed work, whether they be more or less than those shown herein.

The undersigned agrees to complete the work in every detail by August 1, 1941. It is agreed that no progress payments will be made after August 1, 1941, until the final completion of the work, and that a deduction of \$500.00 per day will be made for every calendar day after the above completion date that the Contract is not completed in every detail.

To induce the acceptance of this Bid, the undersigned hereby makes each and every representation and warranty made by the Contractor in the Contract and the other papers bound herewith.

Said Information for Bidders, all papers required by it and submitted herewith, said Contract and all papers made part hereof by its terms, are hereby made part of this Bid.

The undersigned bidder hereby represents as follows:

(a) that no Commissioner, officer, agent, or employee of the Commission is personally interested, directly or indirectly, in this Contract, or the compensation to be paid hereunder; and that no representation, statement or statements, oral or in writing, of the Commission, its Commissioners, officers, agents or employees, has induced him to enter into this Contract excepting only those contained in this form of Contract and the papers made a part hereof by its terms;

(b) that this Bid is made without connection with any person, firm or corporation making a bid for the same work, and is in all respects fair, and without collusion or fraud;

(c) that said bidder has visited and examined the site of the work, and has carefully examined the drawings and the Contract which includes the Information for Bidders, Bid, Contract, Bond, and Specifications, and will execute the Contract and perform all its items, covenants and conditions, all in strict conformity to the requirements of the Specifications and Drawings.

The undersigned hereby designates.....

.....  
as his office to which notices may be delivered or mailed.

Dated ....., 1940

.....  
Name of Bidder  
Corporation, Firm or Individual.

By .....

.....  
Title

.....  
Business Address of Corporation,  
Firm or Individual.

**Receiving and Opening Bids.** Contractors may submit bids at any time prior to the hour designated for their opening, and bids submitted may be withdrawn or changed at any time before the official opening. No changes are permitted after the opening of bids. For submission, the bid, with accompanying papers, should be placed in a sealed envelope addressed to the person authorized to receive bids and endorsed with the bidder's name and the title of the project. At the proper time all bids are opened and read aloud publicly so that all bidders and others interested may be present as witnesses or to tabulate amounts.

**Analysis and Comparison of Bids.** Ordinary lump-sum bids require only a simple comparison of amounts and a survey to detect informalities. Frequently, though, there may be large numbers of alternative bids requested to cover substitute types of construction or, perhaps, important variations in the entire project. Such bids will require careful analysis in order to determine the low bidder for the various combinations. Important engineering and financial decisions must also be made at this time inasmuch as the character and scope of the work are not definitely determined until after the bids are opened.

For unit-price contracts the bid consists of a unit price for each item in the engineer's estimate. To compare bids the unit prices are multiplied by the quantities for each item respectively, and the total thus obtained for the entire estimate is considered as a lump sum. If the bid contains an error in the multiplication of the unit prices by the quantities, the unit price should govern, and, if there is an error in addition, the correct sum shall govern. It is understood and should be noted in the instructions to bidders that the engineer's estimate is approximate and that the actual quantities may vary somewhat from those estimated. Therefore the bid comparison is based on approximate costs. The actual cost of the contract can be determined exactly only after the work is completed and the various quantities are measured in place. This sometimes discloses that the apparent low bidder actually was not low, and another contractor would have received the award if the estimate had been more accurate. The estimated quantities are given solely for the purposes of indicating the scope of the work and comparing bids. The unit prices in the bids are binding on the contractor unless there is a gross error in the estimated quantities. It has been held that the engineer's estimate is a repre-

sentation which, if grossly in error, results in a mistake and may provide sufficient grounds for the contractor to obtain a change in unit price. For this reason some contracts provide for a readjustment of the contract unit prices if the actual quantities of work performed should vary from the estimated quantities by more than a stipulated percentage, usually 25 per cent. Such a clause may call for a reconsideration of the entire contract or, more frequently, for a negotiation of new unit prices for the differential quantities.

**Awarding the Contract.** The selection of the contractor requires two independent operations, viz., a study of the qualifications of the bidders to eliminate irresponsible and undesirable contractors and an analysis and comparison of bids to determine the lowest responsible bidder.

Proving irresponsibility on the part of a bidder is a difficult and delicate matter except in the most obvious cases. The default of a previous contract is considered sufficient grounds, and in some quarters litigation in connection with previous contract work will disqualify the bidder. A review of the bidder's experience record to determine his normal capacity for work and a statement of the amount of work he has currently on hand will reveal his available capacity for new work. The contractor's previous record for completing work on time should also be considered. If there appears to be danger of the contractor obligating himself beyond his capacity, he should be disqualified unless he can show evidence of his ability to expand to the necessary extent. Dishonesty, evidence of lack of ability, insufficient working capital, and inadequate surety are likewise grounds for disqualification.

For private works the contract may be awarded to any bidder at the discrimination of the owner. Usually, however, it will go to the lowest responsible bidder unless special considerations outweigh the saving in cost, in which case one of the higher bids may be accepted. Formerly, almost all government statutes required that public works contracts be let to the lowest bidder without reservation. This led to so much difficulty and expense through poor quality of workmanship and defaulted contracts that, except in a relatively few local governments, it is now permitted to award such contracts to the lowest responsible bidder. This allows some control over the qualifications of the contractor to be selected, but if the award is made to other than the lowest responsible bidder it may easily result in responsible bidders re-

fusing to bid on future work for this owner or engineer. The submission of a bid by a contractor entails considerable expense for which he receives no compensation unless he is awarded the contract, and, if he is invited to bid, he has a right to assume that the owner and his engineer will act in good faith in considering his bid.

To establish his qualifications for the contract it may be advisable to require each bidder to furnish a qualification statement with his bid, preferably in the form of a questionnaire, which should include the following information.

- a. A complete and detailed financial statement.
- b. A record of his experience going back at least five years and giving references in connection with each contract.
- c. The particulars in connection with any failures to complete previous contracts.
- d. Names and experience records of the principals and key personnel of his firm.
- e. Explanation of the manner in which he has inspected the proposed work.
- f. A detailed plan for performing the proposed work.
- g. List of equipment available for the proposed work.
- h. List of equipment to be rented and from whom.
- i. List of equipment to be purchased.
- j. Items of work to be sublet and names and addresses of proposed subcontractors if known.
- k. Name of the individual who would have direct personal supervision over the work.
- l. When time of completion is important it may be desirable to require the bidder to submit a preliminary progress schedule with his bid.

**Notice of Award and Notice to Proceed.** After the analysis of bids and selection of the contractor, a formal *notice of award* should be issued to notify the contractor of his selection and should contain instructions as to time and place designated for the signing of the contract. The letter should state specifically the conditions of the award. After the acceptance of the bid and the signing of the contract a formal *notice to proceed* should be forwarded to the contractor authorizing him to begin work. This should be explicit inasmuch as the contract time for completion will be dated in accordance with the conditions therein.

**Letter of Intent.** After bids are opened, considerable time may be required to select the contractor, and additional time will be necessary to prepare the contract documents for execution. When the work is urgent, it may be desirable to avoid some of the delay by authorizing the start of work in advance of the signing of the contract. This may be accomplished by combining a *letter of intent* and the notice to proceed in one communication. It is then necessary that the letter state the character and scope of the work to be done and the compensation the contractor is to receive for his services. It is also necessary that the letter obligate both parties to enter into the contract at a later date, allowing the work to proceed in the meantime. Such a letter is, in effect, a contract to enter a contract, and when accepted it is binding on both parties.

**Unbalanced Bids.** For unit-price contracts, a balanced bid is one in which each bid item is priced to carry its share of the cost of the work and also its share of the contractor's profit. Occasionally contractors will raise the prices on certain items and make corresponding reductions of the prices on others with the total amount of the bid unchanged. The result is an unbalanced bid. In general, unbalanced bids are undesirable and should not be permitted when detected although the practice is sometimes justified from the contractor's viewpoint. Some of the purposes of unbalanced bidding are as follows.

a. To discourage certain types of construction and to encourage others which may be more favorable to the contractor's organization and equipment.

b. When the contractor believes the engineer's estimate for certain items is low, by unbalancing his bid in favor of such items, he can secure an increased profit in the actual payment for the work without increasing the apparent total amount of his bid proportionately.

c. Unreliable contractors may increase the bid prices for the first items of work to be completed with corresponding reductions elsewhere in the estimate with the intention of securing excessive payments on the unbalanced bids and then defaulting the contract. This leaves the surety to complete the work which was underpriced.

d. By unbalancing his bid in favor of the items which will be

completed early in the progress of the work, the contractor can build up his working capital for the remainder of the work.

Of the foregoing reasons for unbalanced bidding, the last has some justification when dealing with reliable contractors. The expenses of mobilizing the construction plant, bringing equipment and materials to the site, and the general costs of getting the work started are appreciable. These items usually do not appear in the bid and, therefore, are liquidated only as the work on the bid items progresses. This causes a hardship to the contractor in that his working capital is tied up in the work to the advantage of the owner. There appears to be no way to overcome this imposition on the contractor without exposing the owner to undue risks.

The prevention of unbalanced bids requires a knowledge of construction costs in order that unreasonable bids on individual items may be detected. An obvious case of unbalanced bidding should be considered sufficient grounds for rejecting the entire bid.

#### EXAMPLE OF AN UNBALANCED BID

For a foundation contract, the engineer's estimate for the purpose of comparing bids indicated a total of 11,000 cubic yards of excavation of which 1,000 cubic yards were estimated to be rock and the remainder earth excavation. A balanced bid of \$5.00 per cubic yard and \$1.00 per cubic yard respectively gives a total cost for excavation of \$15,000. Suppose the contractor by investigations of his own concluded that the engineer's estimate for the quantity of rock excavation was too low and he unbalanced his bid by increasing the unit price for rock excavation and making a corresponding decrease in the unit price for earth excavation. By maintaining the same total of \$15,000 the amount of his bid would not be changed.

ITEM	<i>Engineer's Estimate</i>	BALANCED BID		UNBALANCED BID	
		<i>Unit Price</i>	<i>Amount</i>	<i>Unit Price</i>	<i>Amount</i>
Excavation					
Rock	1,000 cu. yd.	\$5.00	\$ 5,000	\$10.00	\$10,000
Earth	10,000 cu. yd.	1.00	10,000	0.50	5,000
Total			\$15,000		\$15,000

Upon completion of the work suppose it was found by measurement that the actual quantities were: rock excavation, 2,000 cubic yards and earth excavation, 9,000 cubic yards. The amounts that would be paid to the contractor under each of the two bid items are as follows.

ITEM	<i>Actual Quantities</i>	BALANCED BID		UNBALANCED BID	
		<i>Unit Price</i>	<i>Amount</i>	<i>Unit Price</i>	<i>Amount</i>
Excavation					
Rock	2,000 cu. yd.	\$5.00	\$10,000	\$10.00	\$20,000
Earth	9,000 cu. yd.	1.00	9,000	0.50	4,500
Total			\$19,000		\$24,500

By unbalancing his bid as shown, the contractor would have obtained an additional payment of \$5,500 as compared with the balanced bid. This would not have been readily evident at the time of the award of the contract.

**Bidding Practice for U.S. Government Contracts.** The general principles of bidding procedure are applicable, in most instances, for contracts with the U.S. Government. There are some notable exceptions, however. Whereas for private works the contractor may change his bid at any time before the official opening, or withdraw it at any time before its formal acceptance, ordinarily for government work his bid cannot be withdrawn after it has once been opened, during the interval between the opening of bids and the award of the contract. The standard bid form permits the government sixty days after the bid is opened in which to accept it, but the bidder may specify a shorter period if he so desires. Unless he is willing to assume the risk of changing prices or other conditions during this period, the bidder should specify a shorter interval.

The Davis-Bacon Act of March 3, 1931, amended August 30, 1935, requires the acceptance in the bid prices of a scale of minimum wages to be paid all classes of laborers and mechanics. The wage scale is predetermined by the Department of Labor and is included in the specifications for the work.

A mistake in the bid is binding on the bidder unless discovered and changed before the bids are opened. If the low bidder discovers, after the opening of bids, that an error has been made, he may appeal for relief, through the contracting officer, to the Comptroller General. The amount of the claim may not exceed

the difference between the accepted bid and the next low bid, and the Comptroller General's decision in the matter is final. Similarly, if the contracting officer makes a mistake in the acceptance of a bid, the government is bound by the amount accepted.

Separate competitive bids may not be submitted by two corporations when one is a subsidiary, owned and controlled by the other. Consideration will be given to only one bid from such a combination.

When identical bids are received and none appears to have superior advantages to the government, the award may be made by the drawing of lots or by the arbitrary selection of one of the bidders.

**Suggestions for Obtaining Lower Bids.** The character of the bidding information which is furnished to contractors by the engineer will have important effects on the amount of the bid. The following suggestions are offered as a means for eliminating some of the causes of high bids.

*a.* Avoid incomplete plans and specifications. All details, dimensions, types of construction, and the like should be available to the contractor for bidding purposes.

*b.* Do not place the responsibility for incomplete or uncertain data on the contractor. In this event he will have to protect himself against the worst conditions to be expected.

*c.* Whenever practicable allow the contractor sufficient time to complete the work at an efficient rate of production. Emergency conditions may require speedy construction, but it should be understood that the cost of the work will almost always be increased thereby.

*d.* Place the fewest possible restrictions on the contractor, consistent with obtaining the results desired.

*e.* Do not impose unreasonable or unfair conditions on the contractor.

*f.* Do not impose restrictions as to construction methods on the contractor. Specify results.

*g.* In so far as possible use stock sizes and standard products in the design. Do not specify the product of a particular manufacturer, however.

*h.* Review plans and specifications to eliminate all non-essentials.



i. Allow bidders sufficient time between the advertisement and the opening of bids for a careful analysis and estimate of the cost of the work and the conditions under which it will be performed.

j. Establish a reputation among contractors for fair and reasonable requirements during construction and honest, impartial decisions on controversial questions.

**Awarding Subcontracts.** Bids on subcontracts are usually on an informal basis and, strictly speaking, are a matter between the prime contractor and the subcontractor inasmuch as the prime contractor assumes full responsibility for the work so accomplished. Nevertheless the owner should exercise some control over the award of subcontracts by specifying that all subcontractors are subject to the approval of the engineer. This is desirable in order to assure competent workmanship and to avoid delays and other difficulties which might occur with the acceptance of unqualified subcontractors. Whether the selection of the subcontractors should be subject to approval before or after the award of the prime contract is a controversial question. If the prime contractor is required to submit a list of his subcontractors with his bid, some protection is afforded the subcontractors in that the prime contractor is not permitted to bargain with their competitors for better prices after the award and thereby increase his profit over that contemplated by his bid. On the other hand, it is sometimes held that the prime contractor is entitled to receive the benefits of the best bargain obtainable inasmuch as the owner's interests are not involved.

### Questions

1. Why is it desirable to announce by means of an advertisement the taking of bids in connection with the award of a public works contract?
2. What information should the advertisement contain?
3. Write an advertisement for bids for the construction of a water treatment plant by a city department of water supply.
4. What is the purpose of the instructions to bidders?
5. What information should be included in the instructions to bidders?
6. Write the instructions to bidders for the water treatment plant in question 3.
7. Select the bid items and units for a unit-price contract for the construction of a highway. The required construction operations consist of

clearing and grubbing, excavation, embankments, concrete box culverts, fine grading, concrete pavement, guard railing, and fencing.

8. Prepare a bid form for the highway contract in question 7.

9. Explain the procedure to determine whether a bidder is qualified to enter into a construction contract.

10. What is an unbalanced bid?

11. Read and report on "Legal Warranty of Engineer's Boring Data" in *Civil Engineering*, June 1945, page 296.

12. Under a contract for the foundation work and excavation for a public school built for the Board of Education of the City of New York, there was no indication in the record of borings or in the plans and specifications that difficulties would be encountered in the excavation work. When the excavation progressed massive old foundation walls were encountered. The inspectors insisted on the removal of the walls and the resultant extra work increased the cost of the contract to about twice the amount of the bid. The action of the contractor for additional compensation was resisted by the owner on the ground of provisions formulated in the specifications to the effect that "because of the well-understood difficulties under which borings and subsoil explorations are made the owner shall not be held responsible for any differences between indications shown in the plans or other subsoil data and the actual conditions disclosed by excavation," and "no compensation shall be paid the contractor for any differences in the character of the earth to be excavated or for any pumping that may be required." The contractor on the other hand contended that "a difference in the character of the earth to be excavated" applied only to conditions that would be found in natural earth. Who should pay the extra excavation cost? (See *Engineering News-Record*, January 30, 1941, page 60.)

# 5

## COMPETITIVE-BID CONTRACTS

The purpose of a contract is to define, with exactness, the rights and responsibilities of both parties to the transaction. In construction contracts, legal, financial, and engineering considerations are involved, and the relationships between the contracting parties are very complex. Therefore, discerning judgment is a prerequisite in arriving at the appropriate terms to be included. It is significant to note that for competitive-bid contracts the terms, except for the contract amount, are dictated by one party, the owner, without consulting the other because ordinarily he is not known at the time the contract is written. This is a necessary condition since contractors cannot be expected to prepare bids without information as to the contract conditions under which the work is to be performed, but it does have important implications relative to the amounts of bids and the conduct of the work.

Inasmuch as a simple oral agreement or an offer and acceptance by letter is just as binding as a lengthy document setting forth all the conditions in detail, the decision as to the form and content of the contract is a matter of supplementing the essential elements of the agreement to a degree commensurate with the importance and complexity of the work. Though brief contracts are desirable, it is always advisable to sacrifice brevity in favor of clarity in order that the obligations of both parties may be defined explicitly.

The formal contract documents to be accepted and agreed to by both parties consist of the contract, the specifications, and the drawings.\* Of these the contract is the strongest from the legal viewpoint, it being the document which contains the basic promises

\* The advertisement, instructions to bidders, and the bid, although generally classed as contract documents, are not strictly speaking parts of the contract but preliminary to it. They may be incorporated in the contract by reference, however, if this is considered necessary or desirable. Normally these documents do not contain matter of contractual importance, and their

or covenants and which bears the signatures of the contracting parties. If any statements of contractual importance are placed in the advertisement or instructions to bidders, these documents must be made parts of the contract by reference, or the statements must be repeated in one of the formal contract documents.

**Language of the Contract.** All contract documents should be written in a simple style and in so far as possible they should be self-explanatory. Unusual technical terms should be defined where they occur and it is sometimes advisable to devote one article in the contract to definitions of general terms including the various contract documents, the parties to the contract, the engineer, contractor, subcontractor, and the like. The purpose of these definitions is to limit the meaning of significant terms to that intended throughout the contract documents rather than to give general definitions of words which may have several meanings, depending on how they are used.

The parties to the contract are mentioned throughout as if each were singular in number. The designations "Party of the First Part" and "Party of the Second Part" which were formerly used are now seldom encountered in construction contracts. Instead, direct reference is made to the Owner, the Contractor, or the Engineer. Acceptable alternatives to the Owner are the Company, City, State or Government as the case may be. In government contracts the authorized representative of the government agency having cognizance over the work will be a contracting officer who acts for the government. He in turn will be represented by an officer in charge in lieu of the engineer. Each of these terms should be defined.

In the past it has frequently happened that construction contracts have been written in such complex legal language as to obscure the meaning intended. In general, the trend is away from legal phraseology and other esoteric terms and toward simple, direct language which is in common use. Most lawyers as well as engineers and contractors favor this practice which results in documents which are clear and understandable to those without technical and legal training.

inclusion would be pointless except as evidence of the intentions of the contracting parties. An exception would exist when no formal contract is executed. In this case, the bid, together with the acceptance, would comprise the agreement.

**Form of the Contract.** Contracts for construction work follow legal practice and are encountered in many different forms. In general, all contain an introduction or preamble which states the date of the agreement and designates the parties thereto, as in the following.

This Agreement, entered into the ..... day of ....., 19....., by ....., hereinafter called the Owner and ....., hereinafter called the Contractor, Witnesseth that the parties hereto do mutually agree as follows:

After the preamble, the articles or covenants are written. These may be limited to the basic essentials for a valid contract, namely, a statement of the work to be done, the time in which it is to be done, the compensation to be paid for its performance, and the signatures of the contracting parties, affirming their agreement as to the conditions imposed by the contract. Such a brief contract is seldom adequate for construction work, however, and supplemental articles are usually required to define in more particularity the intended rights and responsibilities of the signing parties. These should include a statement that the specifications and drawings are each made part of the contract and that their requirements are equally enforceable. Also, such matters as changes in the work, liquidated damages, control of the work during construction, and the like should be covered. Any special statutes or ordinances relating to or governing the conduct of the work should be incorporated by reference, and the contractor's attention should be directed to them specifically.

It is recognized that it is impossible to write a single contract which would be suitable for all phases of engineering construction. However, certain basic articles are required for all contracts, and these can be more or less standardized. Supplemental articles will depend upon the character and magnitude of individual projects, but many of these are also approaching standardization after repeated use.

The form of the contract is influenced considerably by the methods to be used in its preparation. Some organizations develop a standard form which they consider suitable for all work. This is printed with blank spaces in which are written special clauses pertaining to an individual job, such as a description of the work to be done, the amount of the compensation to the contractor, and

the like. Other articles are standardized in accordance with the owner's general policy and require no individual treatment. Detailed requirements of the work not covered in the contract are incorporated into the specifications which are made a part of the agreement by reference.

The contract is sometimes divided into parts. The first part contains the basic articles relative to the scope of the work, compensation to the contractor, time of completion, and the like and is called the *agreement*. The second part is called the *general conditions of the contract*, and it contains all the supplemental articles. Both the agreement and the general conditions may be standardized and printed for use on all jobs. A third document called the *special conditions* is then written specifically for each job to cover special contractual provisions not included in the standard agreement or the general conditions. These three documents, together with the technical specifications and drawings, make up the contract documents. This is the standard procedure recommended by the American Institute of Architects, and it is used for practically all building construction in the United States. For engineering construction there appears to be no advantage in dividing the contract into parts in this manner. In fact, the contract is complicated unnecessarily by the addition of two extra documents. The contract procedure is simplified considerably by placing all the legal and general contractual requirements in the contract proper, and this document can be standardized and printed if desired. Specific requirements for a particular job and exceptions or amendments to the standard articles can be placed in the general provisions of the specifications, thereby eliminating the general conditions and the special conditions, as separate documents, from the contract papers. The discussions of contracts and specifications throughout this book are based on the latter procedure because of its simplicity in outlining and classifying the contents of the contract documents.

The articles of the contract should be followed by a final or concluding paragraph affirming the agreement as in the following.

In witness whereof, the parties hereto have executed  
this Agreement as of the day and year first above written.

This is followed by the signatures of the contracting parties and the signatures of the witnesses.

**Articles of the Contract.** In general, the articles of the contract are legal in nature and deal with the contractual promises of the signing parties. Inasmuch as the specifications and drawings are made part of the Agreement by reference, it might be said that every requirement, whether in the contract, specifications, or drawings, is contractual and that the complete assembly makes up the contract. For convenience, however, distinction is made between these documents, and the requirements of the plans and specifications are valid through a contractual promise in the agreement that the work will be performed in accordance with their provisions. This distinction has legal significance. For instance, when it is necessary to produce the original contract in a lawsuit a copy of the original specifications and drawings will suffice for reference purposes. In all respects, however, the requirements of the contract, the specifications, and the drawings are equally enforceable.

Inasmuch as the articles of the contract and some of the general provisions of the specifications may be of similar character and the boundaries between the documents are not rigidly defined, there will always be a question as to the allocation of some topics. This question can be settled best on the basis of clarity and consistency in composition. Many of the requirements could be placed in either document appropriately. In this connection practice varies from the thought that the contract should be as brief as possible, covering only the essential provisions and allocating all supplemental articles to the other documents; to the opposite extreme in which all legal and business matters are placed in the contract, restricting the specifications to the technical requirements. Probably the best solution is some place between the two. A good rule to follow is that the contract being the document of greatest strength should include, in addition to the basic requirements, all provisions requiring special emphasis and those likely to lead to conflicts. If the contract is being prepared for repeated use on a number of jobs, its subject matter must be kept general with the understanding that the specifications will cover detailed contract requirements although some of these may be similar to the articles of the contract. On the other hand a contract being written for a particular project may contain specific references to that project which would not be feasible in a standard contract form. In either event it is important to note the

relationship between the documents in order to prevent overlapping, omissions, and conflicts.

When a condition is specified completely in one document it should not be duplicated in the others. In this connection it is advisable to cover a topic completely when it is first mentioned rather than to specify it partially in one place and refer to an additional treatment elsewhere in the documents.

The articles of the contract and the specifications as well should be confined to the phases of the contract procedure related to the work after the award of the contract, all matters pertaining to the bidding being covered in the advertisement and the instructions to bidders. The word "bidder" should not appear in the contract.

There is no fixed rule as to the order in which the articles of the contract should appear in the composition and the extent to which they are covered will depend on the terms to be included and also the contents of the specifications. Usually the essential articles are placed directly after the preamble, and they are followed by the supplemental clauses. This sequence is used in the discussion of the various contract articles which follows.

**Statement of the Work.** In this article the services to be performed by the Contractor are defined. These will usually be the furnishing of all materials and labor and the performing of the work in accordance with the requirements of the contract, drawings, and specifications, all of which should be designated specifically by title, number, and date and made a part of the contract. If the contract is divided into parts, such as the agreement, general conditions of the contract, and special conditions, as recommended by the American Institute of Architects, mention should also be made of these supplemental documents. The description of the project should be concise but sufficiently complete to define the scope of the work covered by the contract. The contractor will be required to perform only the work described in this article and that defined in the other contract documents designated, and he will be entitled to extra compensation in addition to the contract amount when any omitted item is recalled.

**Time of Completion.** This article states the date when the work is to begin and the time in which it is to be completed. Usually time is measured from the date of the signing of the contract. The contractor is allowed a reasonable interval after this date,



usually ten days, in which to get the work started. The time of completion may be set at a specific calendar date, or the contractor may be allowed a specific number of days in which to complete the work. In the latter method, it is always advisable to specify *calendar* days which includes Sundays and holidays otherwise there will always be a question as to what time is intended. The use of *working* days in this connection is indefinite. In fixing the time of completion, a reasonable period should be allowed for the contractor to complete his work. A time schedule requiring extra equipment and workmen and overtime work, as compared with normal progress, will always result in increased construction costs. These extra cost factors must be weighed against the urgency for the completed work. Frequently the benefits to the owner of being able to place the completed work into service at an earlier date will justify the extra cost required, but otherwise the amount of the contract will be increased unnecessarily.

**The Contract Amount.** This article states the amount the contractor is to receive in consideration for the accomplishment of the work. The consideration will be a lump sum or unit prices or possibly both, depending on the basis of the bid. Excepting this article the contract form may be the same for both lump-sum and unit-price contracts.\* For unit-price contracts a statement should be included permitting an equitable adjustment in unit prices if the quantities originally contemplated should be so changed that the application of the contract unit prices would create a hardship to either the owner or the contractor. This qualification is sometime left indefinite to be negotiated at the time of the change in the quantities. It is preferable, however, to state in the contract the limit of variations from the estimated quantities, which will be allowed with no change in the contract unit prices. This is usually set at 20 per cent to 25 per cent of the original estimated quantities. If it is desired to fix in advance the changes in unit prices to cover variations from the original estimated quantities the bid may be worded to provide unit-price quotations for various increments more or less than the base estimate. The payment article of the contract would then contain corresponding provisions. The statement of the work, time

\* Methods of measurement and payment for bid items under unit-price contracts normally are covered in the specifications.

of completion, and the contract amount are frequently combined in one article of the contract.

**Liquidated Damages.** Closely related to the contract amount, the article on liquidated damages when used covers the situation in which the contractor fails to complete the work within the time specified and thereby causes the owner to suffer losses and other hardships. In order to be valid this article should declare that time is of the essence of the contract, that is to say, time is part of the consideration of the agreement. Actual damages are difficult to determine exactly and in lieu thereof both parties agree to the payment to the owner by the contractor of a predetermined lump sum for each day of delay until the work is completed. This lump sum is not to be considered as a penalty but as the liquidated actual damages which the owner would suffer as a result of the failure of the contractor to complete the work as agreed, and the contract should so state. Penalties are difficult to enforce under contract law.

In arriving at the amount to be assessed as liquidated damages, it must be kept in mind that this amount is intended to be a measure of the actual damages suffered. Although agreed to in the contract, liquidated damages may be challenged at any time by the contractor if it appears that the amount is unreasonable as compared with the actual loss suffered by the owner on account of the delay. Under these conditions the owner must be able to justify the amount, or it may be revised or voided by the court.

Provision should also be made to grant extensions of the contract time of completion for any delays resulting from causes beyond the contractor's control, which are not to be considered normal hazards of the contract. Delays of this classification, such as those due to acts of God, disasters, strikes, and the like are deducted from the time for which the contractor is liable for liquidated damages.

**Bonus Clauses.** As an incentive for the contractor to complete the work before the date specified, a bonus clause is sometimes written into the contract providing for the payment to the contractor of an additional lump-sum amount for each day the completed work is available for use by the owner prior to the time of completion specified in the contract. Ordinarily the amount of the bonus payment should be consistent with the pro-

vision for the payment by the contractor of liquidated damages for delays.

Bonus provisions have the effect of strengthening liquidated damage clauses because of the tendency of the courts to view liquidated damages alone as a penalty without a corresponding consideration. Although liquidated damage clauses are valid without bonus provisions proponents of the latter hold that it is only equitable to permit the contractor to profit by performance better than that anticipated if he is to be penalized for failure to do so. On the other hand opponents object to bonus clauses because of the additional speculative element introduced into the contract. Bonus clauses are not permissible in U.S. Government contracts.

**Supplemental Articles.** When accepted and signed by the contracting parties, the foregoing articles satisfy the essential legal requirements for a valid contract, but because of the complexity of most construction projects they are seldom adequate to define the intentions of the parties and additional covenants are needed. The topics to be covered will depend on the magnitude and character of the work, but the usual practice is to include only such contractual provisions as will apply to any project. This permits the contract to be standardized and printed for general usage. All unique features of a particular project may then be covered in the specifications and made part of the contract by reference.

The supplemental articles most frequently used in current practice may be classified broadly under the following headings.

- a.* Plans and specifications.
- b.* Responsibilities and rights of the owner during construction.
- c.* Authority and duties of the engineer.
- d.* Responsibilities and rights of the contractor.
- e.* Progress and control of the work.
- f.* Payments to the contractor.
- g.* Insurance, safety, and sanitation.

Each of the foregoing classifications may require several articles in the contract. When the contract is to be divided into parts these supplemental articles normally would be placed in the part termed general conditions of the contract.

**Plans and Specifications.** The articles under this classification give the contract requirements relative to the intent of the plans and specifications, conflicts, omissions and errors, and the like. Some contracts also contain a general article pertaining to shop drawings and other drawings to be prepared by the contractor. It is advisable to require a minimum of this type of work by the contractor, however, as such requirements usually result in a disproportionate increase in the cost. For this reason, it is usually preferable to cover shop drawings in detail in the specifications.

Some states have laws which require that all contracts, plans, and specifications for work, the cost of which exceeds a specified amount, shall be registered. When this is required the contract should contain an article placing responsibility for the registration either on the owner or the contractor. Unless the requirements of the law are complied with in this respect, the validity of the contract may be endangered.

The article covering the intent of the plans and specifications deserves special attention. This article usually states that all work called for in the specifications and not shown on the plans or shown on the plans and not called for in the specifications shall be of like effect as if shown or mentioned in both. If a conflict should exist between the provisions of the specifications and those of the drawings the specifications usually govern. Omissions from the drawings or specifications, or the misdescription of details of the work, which are evidently necessary to carry out the intent of the plans and specifications normally do not relieve the contractor from performing such omitted or misdescribed work. Under this article he is required to perform all work necessary to provide a complete structure as if it were fully and correctly described in the plans and specifications. The fairness of this requirement is open to question, but it is used almost universally and is enforceable when the plans and specifications are sufficient to indicate clearly the general intentions in connection with the work. A contract to perform work according to specific plans and specifications implies that they are understood.

The contractor sometimes is required to "guarantee the sufficiency of the plans," making him responsible for the adequacy of the design and this provision also is enforceable when agreed to

by the contractor. Under this condition, the contractor may be held liable for a failure even though the work was performed in accordance with the plans and specifications.

With regard to the interpretation of the plans and specifications, the engineer should be given authority to decide all questions, disputes, or conflicts, and all work should be performed in accordance with his directions. In this connection the contractor should be required to check all drawings and report any discrepancies to the engineer for his determination. When dimensions are affected by existing conditions the contractor should be required to take measurements notwithstanding any scale or figure dimensions on the drawings and report such information to the engineer.

No changes or deviations from the drawings and the dimensions given therein should be permitted without authority from the engineer regardless of whether or not error is believed to exist.

**Responsibilities and Rights of the Owner during Construction.** In general, very few direct contacts are necessary between the owner and the contractor after the contract is signed, all details of the work being handled for the owner by the engineer. This procedure should be rigidly adhered to in order to prevent divided or conflicting authority on the job. Therefore, one of the owner's first responsibilities is to designate in the contract a representative, usually the engineer, who shall have complete charge of the work and the authority to direct and supervise all operations in so far as the owner's interests are concerned. He is also obliged to furnish the land on which the work is to be performed, all the property surveys required to establish the boundaries of the site, and the funds for prompt payment to the contractor of all monies due under the contract, but these items ordinarily are not matters to be covered in the contract.

With regard to the rights of the owner, reservation should be made in the contract for him to perform work with his own forces or to let other contracts in connection with the work and to require the contractor to connect and coordinate his work with that of others without interference to either. Unless provisions are made to the contrary the contractor may be entitled to extra compensation if he is delayed or otherwise suffers damages because of interference by the owner's forces or those of other contractors on the job.

On most construction projects it is desirable for the owner to take possession and use any completed portions of the work irrespective of the time of completion of the entire contract. Use of portions of the work in this manner should not constitute acceptance which should be considered only when the entire project is completed. It should be noted that use of portions of the work by the owner may delay or interfere with the contractor's operations in the remainder, and if so he is entitled to extra compensation unless provisions are made to the contrary.

The owner may assert the right to suspend work under the contract temporarily if it appears to be in his interest to do so. The contractor should then be required to resume work upon receipt of written notice from the owner. This article should provide for reimbursement to the contractor to cover any expense incurred by him as a result of the suspension of the work. It is unreasonable to expect a contractor to stand by indefinitely under a temporary suspension order, and the contract should permit him to abandon the work completely if the suspension is not lifted within a specified time, say ninety days. He is then entitled to payment for all work done on the abandoned portions of the project.

**Changes in the Work.** Frequently in the course of construction work it becomes necessary to make changes in the plans and to introduce additional work which was not contemplated at the time of the award of the contract. In a similar manner, it may become desirable to omit certain parts of the project which were included in the contractor's bid. In either case it is necessary to revise the contract by the issuance of a change order. This should always be done in writing, and no changes should ever be undertaken on the basis of verbal orders, except in an emergency. The change order may be in letter form and should state explicitly the work required and the price to be paid to the contractor, if the change involves any additional cost, or the credit to be allowed the owner, if the change involves a reduction in cost.

The method of arriving at the cost of changes should be given careful consideration by the engineer, and an agreement with the contractor, as to the amount, should be made before he is authorized to proceed, in order to avoid disputes after the work is completed. The following are the usual methods of payment for changes.

a. The actual cost of the change plus a percentage of the cost, usually about 10 per cent for overhead and 6 to 10 per cent for profit.

b. The actual cost of the change plus a fixed fee determined in advance of the work on the basis of the estimated cost.

c. A lump-sum amount to cover all costs and profit to the contractor.

d. Unit prices to cover all costs and profit to the contractor.

It is essential that every construction contract shall permit the owner to order extra work or make changes by altering, adding to, or deducting from the work at any time without invalidating the contract or the contractor's bond. All such changes should be executed under the conditions of the original contract except that the cost of the extra work or changes and any claims for extension of time caused thereby should be adjusted at the time the change is ordered. The cost of changes may be established in the contract on the basis of cost plus a specific percentage or methods for arriving at the cost by negotiation may be specified as described above. When changes are anticipated unit prices for additions and deductions may be obtained in the original bid.

The amounts involved in changes and extra work are contractual matters to be negotiated between the owner and the contractor, when not provided for in the original contract, inasmuch as it is usually impracticable to request bids from others. Ordinarily the engineer does not have the right to order changes in the work unless he is expressly authorized to do so by the owner.

**Termination of the Contract.** The owner may reserve the right to terminate the contract by written notice without fault of the contractor at any time when it is in his interest to do so. When this is done the contractor is entitled to compensation for all work done by him prior to the time of annulment and for all expenses not otherwise paid for and as are required in abandoning the work. The engineer should be authorized to determine the amounts of such expenses.

The contract also may be terminated by the owner because of the failure of the contractor to perform in accordance with the requirements of the contract. The conditions which should be considered sufficient causes for annulment because of the contractor's breach of the contract are as follows.

- a.* If the contractor should be adjudged bankrupt.
- b.* If he should make a general assignment<sup>7</sup> for the benefit of his creditors.
- c.* If he should persistently or repeatedly fail or refuse to supply enough properly skilled workmen or proper materials.
- d.* If he should fail to make prompt payment for materials or labor or to subcontractors.
- e.* If he should persistently disregard laws, ordinances or the instructions of the engineer.

When the engineer determines that sufficient cause exists the contractor should be given written notice that his employment is terminated, and the owner may take possession of all materials, tools, and equipment on the premises and finish the work by the most expedient method at the expense of the contractor or his surety. The expense of finishing the work, including all additional costs for managerial and administrative services, should be determined by the engineer.

**The Authority and Duties of the Engineer.** During construction the engineer serves in a dual capacity. He is the authorized representative of the owner for the purpose of supervising and inspecting the work to make certain that all operations are performed in accordance with the requirements of the contract. Also he is the interpreter of the plans and specifications and the arbiter of disputes. The owner is fully within his rights in designating a representative to act for him, but questions of interpretation and arbitration can be assigned to the engineer for decision only on the mutual assent of both parties to the contract. Careful distinction must be made between designation and mutual agreement in this respect. The anomalous situation in which the authorized representative of one party to a contract may also act as the unbiased referee of disputes between the two parties is acceptable only because of the professional integrity of the engineer.

As the representative of the owner it is the engineer's duty to establish all lines and elevations; to make all field measurements necessary to determine the amounts of payments to the contractor; to inspect all materials and workmanship furnished by the contractor; and to see that the work conforms to the requirements of the design; and, in exceptional cases, to establish the order or



precedence of operations and construction methods. The latter prerogative should be exercised only when required by conditions of the design or when the owner's interests are involved. It is desirable that the contractor be given a free hand, in so far as is practicable, in matters of construction procedure and methods. Under an independent contractor relationship, control of the methods for accomplishing the work is vested in the contractor since he is obligated to produce specific results. This relationship is destroyed if the owner or the owner's representative assumes excessive control of the work, and the laws of agency may be invoked. However, it should be noted that the contractor assumes full responsibility when he acts contrary to the specific requirements of the contract.

As the arbiter of disputes it is the engineer's duty to interpret the requirements of the contract and, in case of errors or omissions, to define the intentions of the plans and specifications. His decisions should be based on professional judgment and should be impartial in all respects. Actually the jurisdiction of the engineer is restricted to the settlement of questions of fact. In the last analysis questions of the law of the contract can be decided only by a board of arbitration or a court of law. Therefore, the usual stipulation that "the engineer's decisions shall be final and binding on both parties" cannot be enforced literally. Even on questions of fact it is desirable that provision be made for either party to appeal to a higher authority. Under government contracts such appeal may be made to the contracting officer and, beyond him, to the head of the department having cognizance over the work. If the engineer's decision is not acceptable on private work a board of arbitration is the only alternative to settlement by litigation.

The status of the engineer during construction should be defined in a few carefully worded articles in the contract, the first of which should state that the work shall be subject at all times to his supervision and direction. He should be given authority to determine the amount or quantity of the various kinds of work, and the quality of materials and workmanship to be paid for under the contract and to decide all questions which may arise relative to the performance of the work. This article should also provide that any question as to meaning of the plans and specifications and any obscurity or discrepancy in their wording and intent shall be decided by the engineer and his decision shall be binding on both

parties to the contract. Errors or omissions in the plans and specifications should be amended or corrected by the engineer consistent with a reasonable interpretation of the intent of the plans and specifications.

Construction contracts frequently provide that all lines and grades and other construction surveys will be furnished by the engineer. However, practice in this respect varies. For the construction of buildings, bridges, and similar structures the contractor is sometimes required to perform all layout and survey work with the provision that base points and elevations only will be furnished by the engineer. Therefore, if the contract is to be used for several kinds of work, it is advisable to cover layouts and construction surveys in the specifications rather than in the contract.

The article on inspection and examination of the work should be thorough and complete. It should provide that all materials and workmanship shall be subject to inspection and test by the engineer at any and all times, and, when found by the engineer to be in variance with the requirements of the plans and specifications, all defective work shall be removed and replaced at the contractor's expense. Failure to remove such defective work should be considered sufficient grounds to terminate the contract. Reservation should be made, however, that defective work may be retained if desired by the owner, but when this is done there should be a reasonable adjustment in the contract price.

Inspectors, if mentioned at all, should be established as representatives and assistants of the engineer with authority to reject materials until the question can be referred to the engineer but with no authority to obligate the engineer in any way. Ordinarily inspectors are not authorized to revoke or alter any of the requirements of the plans and specifications or to approve or accept any portion of the work.

**Responsibilities and Rights of the Contractor.** In prescribing the responsibilities of the contractor, it should be kept in mind that the main objective of the contract method is that the work shall be done by a skilled constructor in order to relieve the owner of all responsibilities in connection with management, purchase of materials, employment of labor, and construction operations. The contract price is assumed to include a reasonable profit to the contractor for the accomplishment of this objective.

Therefore, the contract should establish a clear understanding as to the scope of the contractor's obligations, with the detailed instructions set forth in the plans and specifications.

The contractor should be required to designate a representative who is authorized to act for him in all matters pertaining to the contract when he himself is not available. The contractor's representative will usually be the construction superintendent. This designation is necessary in order that there may be some one on the job at all times to whom directions and instructions may be issued with the same effect as if delivered to the contractor in person.

Along with changes and extra work orders, the matter of local conditions at the site of the work is the source of more controversies and disputes than any other condition of the contract, and the owner's intentions in this respect should be clearly stated. Latent or subsurface conditions frequently cannot be determined definitely before the beginning of construction. On private work the contractor is usually obliged to accept full responsibility for the conditions encountered, it being stated that the information given relative to these conditions is the best obtainable, but the owner accepts no responsibility as to its accuracy, and the contractor is to use it at his own risk. U.S. Government contracts, on the other hand, allow a reasonable adjustment in the contract amount if subsurface conditions are later found to be materially different from those indicated on the plans.

Traditionally it was customary to preface each section of the specifications with a statement to the effect that, "The contractor is to furnish all materials, equipment, and labor necessary to construct or install the following work. . . ." Much needless repetition can be avoided by including one such statement in the contract to cover all work contemplated by the plans and specifications with such exceptions as may be noted in the specifications. The exceptions will usually be any materials or labor scheduled to be furnished by the owner or other contractors. Note also should be made of these exceptions in the instructions to bidders.

In connection with the materials, equipment, and processes required, it should be stipulated, unless otherwise provided for, that all royalties and license fees are to be paid by the contractor and that he shall be responsible in all cases of suits or claims for in-

fringement of patent rights. Similarly, the contractor is usually required to provide all building permits.

The conditions under which the contractor has the right to terminate the contract should be defined. In general, the contractor is entitled to terminate the contract if the owner fails to make payment as prescribed in the contract or if the work should be suspended by the owner or by order of a court for a period longer than a specified time, usually three months. A suspension of longer duration may introduce changed conditions with respect to materials prices and wage rates, and the contractor should not have to bear any excess expenses caused thereby.

The contract should be explicit as to the responsibility for delays to the contractor caused by acts of the owner or by other contractors employed on the work. In current practice it is sometimes considered that such delays constitute a normal hazard of the contract and therefore are not sufficient grounds for an extension of the time of completion when liquidated damages are concerned. Many contractors protest that this is an unfair interpretation and claim that a contractor is entitled to an extension of time and possibly the payment of damages when he is delayed or otherwise suffers loss because another contractor's work is behind schedule. There is much to be said for this argument, and it appears that the most equitable solution is to permit extensions of time when the contractor suffers unreasonable delay because of acts of the owner or other contractors as determined by the engineer. The accurate determination of damages under these conditions is very difficult and in case of disagreement arbitration is recommended for the settlement of any questions along this line. The contractor is also entitled to an extension of time to cover delays to the work caused by unavoidable delays in transportation, fire, strikes, floods, and like casualties. Bad weather normally does not justify an extension of time unless it can be shown conclusively that such weather is unprecedented and could not have been anticipated as a normal hazard of the contract.

**Progress and Control of the Work.** The purpose of the articles under this heading is to establish general requirements regarding the quality of materials and workmanship, schedules of progress of the work, approval of subcontracts, employees of the contractor, and similar items dealing with the conduct of the work. These should be stated in general terms so as not to conflict with

detailed requirements in the specifications. It is intended that the control of the work should be vested in the owner, through the engineer, in such a manner that the owner's rights and interests will be protected without limiting the contractor's freedom to plan and administer the conduct of the work along the lines best suited to his organization and equipment.

Before the work is started and materials ordered the contractor should be required to consult with the engineer relative to materials, equipment and methods for prosecuting the work. The work should be carried on at such time and in such parts of the project and with such forces of workmen, materials, and equipment as may be ordered by the engineer to complete the work in accordance with the plans, specifications, and contract. The contractor should be allowed to work at night or outside regular working hours only on the written permission of the engineer and then only after suitable arrangements have been made to inspect the work in progress and after the contractor has provided satisfactory lighting and has complied with other requirements and regulations for night work.

One article should be devoted to the quality of workmanship and materials. Unless otherwise specified, it is intended that all materials, workmanship, equipment, and articles incorporated in the work are to be of the most suitable grade of their respective kinds. Where such items are referred to in the specifications as "equal to" any particular standard the engineer shall decide the question of equality. Information concerning materials and equipment including samples should be submitted to the engineer for approval when required.

Most contracts authorize the engineer to remove from the work employees of the contractor considered incompetent, careless, insubordinate, or otherwise objectionable. This prerogative must be used with the utmost discretion, or the contractor's status as an independent contractor may be converted to that of an agent of the owner thereby relieving him of many responsibilities under the contract.

The contract should also require the contractor to submit the names of all subcontractors to the engineer for approval as soon as practicable after the contract is signed. No subcontractor shall be employed until such approval is obtained. Full responsibility

for the acts and omissions of subcontractors is placed upon the contractor, and nothing contained in the contract should create any contractual relation between any subcontractor and the owner.

A general article is sometimes included requiring the contractor to furnish a schedule of expected progress which shows the dates on which the various parts of the work are expected to be begun and completed. On important work, however, there will usually be special requirements as to the sequence of operations and work to be furnished by others. When this is contemplated the requirements relative to progress schedules can be covered more effectively in the specifications.

Upon the completion of the work the contractor should be required to remove from the owner's property and from all public and private property at his own expense all temporary structures, equipment, rubbish, and waste materials resulting from his operations.

**Payments to the Contractor.** As the work progresses, the contractor is entitled to partial payments which are made on the basis of the engineer's estimates of the amount of the work completed. On lump-sum contracts the estimate will be expressed as a percentage of the total work to be done. For unit-price contracts the engineer will measure the quantities of work completed under each item, and these will indicate the degree of completion. In arriving at the amount of the partial payment, consideration may be given to the amount of material delivered to the site and work done by the contractor at his assembly plant, as well as to completed work. Partial payments are usually made by the owner once each month, although on large contracts it may be desirable to pay semi-monthly in order to reduce the amount of working capital required by the contractor.

Partial payments usually cover 90 per cent of the work completed during the payment period, 10 per cent being retained by the owner as protection against claims or charges against him because of some act or omission on the part of the contractor. Possible grounds for such claims or charges are as follows.

- a. Failure of contractor to reimburse subcontractors, material dealers, or employees.
- b. Damage to adjacent property or to another contractor.
- c. Defective work not corrected.

*d.* Evidence that the work cannot be completed for the unpaid balance.

*e.* Evidence that the contractor may default.

The final payment to the contractor will include the retained percentage as well as the amount due for the work completed during the last payment period. Before the final payment is made, however, the engineer will make the final inspection of the work as a condition of its formal acceptance by the owner. The final inspection will determine any omitted portions of the work, all defective work to be corrected, and any deductions to be made in the contract amount for defective work to be accepted in lieu of its removal and replacement. The contractor should be required to deliver to the owner a release of all claims or liens arising out of the contract before the final payment is made. If any claims or liens are outstanding against the contractor, the amount claimed should be deducted from the final payment and retained by the owner until the matter is settled. If the contractor has any unsatisfied claims against the owner for damages, extra work, or other reasons, the release should be required notwithstanding, specific exceptions being included in the release to cover the unsatisfied claims.

**Insurance, Safety, and Sanitary Requirements.** The hazards and risks incident to construction operations are innumerable, and careful control is necessary to reduce the probability of accidents to a minimum. It is understood that the contractor accepts the responsibility for damages to persons or property due to acts, omissions, or accidents during construction. This, however, will not be sufficient to provide full protection to the owner since suits or claims for damages may name him, as well as the contractor, as a defendant. Furthermore, there is the matter of possible loss due to fire, storms, floods, thefts, and similar occurrences during construction. The most positive method to protect the owner fully is by means of insurance, and the requirements in this connection should be specified in the contract. A construction contract is not one of insurance also unless it is so stipulated.

The common risks in construction work are injury to the contractor's employees, injury to other persons or to property other than that owned by the contractor, and damage to the owner's or the contractor's property due to unforeseen occurrences. Injury

to workmen on the job should always be covered by workmen's compensation and employer's liability insurance at the contractor's expense. To avoid loss from damage claims arising out of injuries to persons not connected with the work or to property other than that owned by the contractor, public liability insurance should also be required. Practice varies with respect to insurance to cover loss by fire, wind, theft, floods, and the like. Comprehensive insurance of the builder's risk type is frequently specified. If the contractor is required to deliver a completed structure before the owner assumes title to the work, the responsibility rests with the contractor as to whether he will protect the completed portions of the work with insurance. On the other hand, the interests of the owner may indicate the advisability of complete insurance coverage as the work progresses, and he may elect to obtain the insurance himself at his own expense; or he may require the contractor to obtain it under the contract. In any event, the types and amounts of insurance desired should be determined and specified before the contract is let, inasmuch as the bid prices will be affected.

Closely allied to risks and insurance are the matters of safety precautions and sanitation. Specific instructions should be included relative to barricades around openings, ladders, warning signs, and the like; also provisions should be made for the location and construction of toilets and other sanitation facilities. These matters are the responsibility of the contractor, as is the removal of such facilities when the work is completed.

**Subcontracts.** As previously noted it is not expected that any one construction contractor will be equally skilled in all the specialized trades and techniques required for a major construction operation, and frequently the services of specialty contractors are utilized under subcontract agreements. In this procedure the general contract known as the prime contract is drawn between the owner and the general contractor. The contractor becomes responsible to the owner for all the work within the scope of the contract. This holds for work actually accomplished by his own forces as well as that performed by subcontractors. Furthermore, the prime contractor assumes responsibility for the management, scheduling, and coordination of the subcontractor's work as well as for his own. The latter element is of great importance in some types of work, especially in the construction of large buildings



where many types of specialized trades are required at specific stages of the work. Typical of such trades are electrical work, heating, air conditioning, plumbing, roofing, automatic sprinklers, structural steel erection, and sometimes excavation and foundation construction. The prime contractor usually performs such work as concrete, masonry, carpentry, plastering, and painting.

Frequently the agreement between the prime contractor and the subcontractor is an oral one or an offer and acceptance by letters. For more important work, however, a formal subcontract is recommended in order to define the rights and responsibilities of the parties and thus minimize the likelihood of misunderstandings and disputes during and after the accomplishment of the work. The form of the subcontract should be similar to that between the owner and the prime contractor. It should define the scope of the work to be performed by the subcontractor, the compensation which he is to receive from the prime contractor, and the time during which the work is to be performed. In addition, it should be stipulated that the subcontractor is bound by the terms of the prime contract, the plans, and the specifications in so far as the work included under the subcontract is concerned. The formal subcontract may include other terms required to prescribe the special relationships between the prime contractor and the subcontractor, in which case it should be stated that, if a conflict exists between any of the requirements of the prime contract and those of the subcontract, the terms of the prime contract are to govern, and the parties are so bound. The right to approve or disapprove the selection of any subcontractor should be reserved by the owner in the prime contract.

In connection with the quality and quantity of the work, the subcontractor is not recognized by the owner. In such matters, the owner holds the prime contractor directly responsible for the subcontractor's work. It should be noted, however, that the subcontractor has very definite legal rights which have important implications to the owner. For instance, if the prime contractor should default on payments due the subcontractor, the owner might be held responsible for the indebtedness, and payment could be forced by a mechanic's lien on the structure constructed under the contract. The owner's best protection against such action is to require the prime contractor to furnish a surety bond guaranteeing the payment of all costs for materials, wages, and other

expenses in connection with the work, including payments to subcontractors. The owner should also require the prime contractor to furnish releases from all claims and liens in connection with the work, executed by all subcontractors, before the final payment is made to the prime contractor.

**Standard Contracts.** In this chapter the writing of competitive-bid construction contracts has been discussed in general. For a guide in the composition of the detailed requirements and the wording and arrangement of the articles, a study of the standard documents of the various technical societies and government agencies is recommended. As examples of typical practice, the United States Government standard form for construction contracts, the uniform contract form of the American Railway Engineering Association, and the standard agreement and general conditions of the contract of the American Institute of Architects are reproduced here for reference.

The United States standard form was prepared by a joint committee of representatives of the various governmental agencies having cognizance over construction work and is used for practically all government contracts except during war emergencies. It differs from contracts for private construction in that it contains a number of articles required by statute law to be included in all U.S. Government contracts. In this connection reference is made to Article 11, Eight-Hour Law, Overtime Compensation, Convict Labor; Article 12, Covenant against Contingent Fees; Article 14, Officials not to Benefit; Article 17, Rate of Wages; Article 18, Domestic Preference; and Article 19, Non-Rebate of Wages.

The uniform contract of the American Railway Engineering Association is one of the oldest of the standard contracts and is representative of current practice for private engineering construction work.

The agreement and general conditions recommended by the American Institute of Articles is used for practically all private building construction in the United States. It also illustrates the method of dividing the contract into two parts whereas in the U.S. Government and the American Railway Engineering Association forms all contractual promises or covenants are consolidated into one document.

Each of the standard forms reproduced herein has been developed and used over a long period covering construction work costing many millions of dollars. Moreover they have been tested many times in court and are believed to represent sound current practice for their respective purposes in the United States.

*EXAMPLES OF COMPETITIVE-BID CONTRACTS*

**STANDARD FORM OF CONSTRUCTION CONTRACT  
USED BY THE U.S. GOVERNMENT**

U.S. Standard Form No. 23—Rev.  
Approved by the Secretary of the Treasury  
Revised April 3, 1942

Contract No. ....

**CONTRACT**

**(CONSTRUCTION)**

THIS CONTRACT, entered into this                      day of                      , 19                      ,  
by THE UNITED STATES OF AMERICA, hereinafter called the Government,  
represented by the contracting officer executing this contract, and

a corporation organized and existing under the laws of the State of                       
a partnership consisting of                     

an individual trading as                      of the city of                       
in the State of                      hereinafter called the contractor, witnesseth  
that the parties hereto do mutually agree as follows:

ARTICLE 1. *Statement of Work.* The contractor shall furnish the materials,  
and perform the work for

for the consideration of

in strict accordance with the specifications, schedules, and drawings, all of  
which are made a part hereof and designated as follows:

The work shall be commenced                      and shall be  
completed

ARTICLE 2. *Specifications and Drawings.* The contractor shall keep on  
the work a copy of the drawings and specifications and shall at all times  
give the contracting officer access thereto. Anything mentioned in the  
specifications and not shown on the drawings, or shown on the drawings  
and not mentioned in the specifications, shall be of like effect as if shown  
or mentioned in both. In case of difference between drawings and speci-  
fications, the specifications shall govern. In any case of discrepancy in the  
figures, drawings, or specifications, the matter shall be immediately sub-  
mitted to the contracting officer, without whose decision said discrepancy

shall not be adjusted by the contractor, save only at his own risk and expense. The contracting officer shall furnish from time to time such detail drawings and other information as he may consider necessary, unless otherwise provided.

ARTICLE 3. *Changes.* The contracting officer may at any time, by a written order, and without notice to the sureties, make changes in the drawings and/or specifications of this contract and within the general scope thereof. If such changes cause an increase or decrease in the amount due under this contract, or in the time required for its performance, an equitable adjustment shall be made and the contract shall be modified in writing accordingly. No change involving an estimated increase or decrease of more than Five Hundred Dollars shall be ordered unless approved in writing by the head of the department or his duly authorized representative. Any claim for adjustment under this article must be asserted within 10 days from the date the change is ordered: *Provided, however,* That the contracting officer, if he determines that the facts justify such action, may receive and consider, and with the approval of the head of the department or his duly authorized representative, adjust any such claim asserted at any time prior to the date of final settlement of the contract. If the parties fail to agree upon the adjustment to be made the dispute shall be determined as provided in article 15 hereof. But nothing provided in this article shall excuse the contractor from proceeding with the prosecution of the work so changed.

ARTICLE 4. *Changed Conditions.* Should the contractor encounter, or the Government discover, during the progress of the work subsurface and/or latent conditions at the site materially differing from those shown on the drawings or indicated in the specifications, or unknown conditions of an unusual nature differing materially from those ordinarily encountered and generally recognized as inhering in work of the character provided for in the plans and specifications, the attention of the contracting officer shall be called immediately to such conditions before they are disturbed. The contracting officer shall thereupon promptly investigate the conditions, and if he finds that they do so materially differ the contract shall, with the written approval of the head of the department or his duly authorized representative, be modified to provide for any increase or decrease of cost and/or difference in time resulting from such conditions.

ARTICLE 5. *Extras.* Except as otherwise herein provided, no charge for any extra work or material will be allowed unless the same has been ordered in writing by the contracting officer and the price stated in such order.

ARTICLE 6. *Inspection.* (a) All material and workmanship (if not otherwise designated by the specifications) shall be subject to inspection, examination, and test by Government inspectors at any and all times during manufacture and/or construction and at any and all places where such manufacture and/or construction are carried on. The Government shall have the right to reject defective material and workmanship or require its correction. Rejected workmanship shall be satisfactorily corrected and rejected material shall be satisfactorily replaced with proper material without charge therefor, and the contractor shall promptly segregate and remove the rejected material from the premises. If the contractor fails to proceed at once with the replacement of rejected material and/or the correction of defective workmanship the Government may, by contract or otherwise, replace such material and/or correct such workmanship and charge the cost thereof to the contractor, or may terminate the right of the contractor to proceed as provided in article 9 of this contract, the contractor and surety being liable for any

damage to the same extent as provided in said article 9 for terminations thereunder.

(b) The contractor shall furnish promptly without additional charge, all reasonable facilities, labor, and materials necessary for the safe and convenient inspection and test that may be required by the inspectors. All inspection and tests by the Government shall be performed in such manner as not unnecessarily to delay the work. Special, full size, and performance tests shall be as described in the specifications. The contractor shall be charged with any additional cost of inspection when material and workmanship is not ready at the time inspection is requested by the contractor.

(c) Should it be considered necessary or advisable by the Government at any time before final acceptance of the entire work to make an examination of work already completed, by removing or tearing out same, the contractor shall on request promptly furnish all necessary facilities, labor, and material. If such work is found to be defective in any material respect, due to fault of the contractor or his subcontractors, he shall defray all the expenses of such examination and of satisfactory reconstruction. If, however, such work is found to meet the requirements of the contract, the actual cost of labor and material necessarily involved in the examination and replacement, plus 15 percent, shall be allowed the contractor and he shall, in addition, if completion of the work has been delayed thereby, be granted a suitable extension of time on account of the additional work involved.

(d) Inspection of material and finished articles to be incorporated in the work at the site shall be made at the place of production, manufacture, or shipment, whenever the quantity justifies it, unless otherwise stated in the specifications; and such inspection and acceptance, unless otherwise stated in the specifications, shall be final, except as regards latent defects, departures from specific requirements of the contract and the specifications and drawings made a part thereof, damage or loss in transit, fraud, or such gross mistakes as amount to fraud. Subject to the requirements contained in the preceding sentence, the inspection of material and workmanship for final acceptance as a whole or in part shall be made at the site.

**ARTICLE 7. *Materials and Workmanship.*** Unless otherwise specifically provided for in the specifications, all workmanship, equipment, materials, and articles incorporated in the work covered by this contract are to be of the best grade of their respective kinds for the purpose. Where equipment, materials, or articles are referred to in the specifications as "equal to" any particular standard, the contracting officer shall decide the question of equality. The contractor shall furnish to the contracting officer for his approval the name of the manufacturer of machinery, mechanical and other equipment which he contemplates incorporating in the work, together with their performance capacities and other pertinent information. When required by the specifications, or when called for by the contracting officer, the contractor shall furnish the contracting officer for approval full information concerning the materials or articles which he contemplates incorporating in the work. Samples of materials shall be submitted for approval when so directed. Machinery, equipment, materials, and articles installed or used without such approval shall be at the risk of subsequent rejection. The contracting officer may require the contractor to remove from the work such employee as the contracting officer deems incompetent, careless, insubordinate, or otherwise objectionable, or whose continued employment on the work is deemed by the contracting officer to be contrary to the public interest.

**ARTICLE 8. *Superintendence by Contractor.*** The contractor shall give his personal superintendence to the work or have a competent foreman or superintendent, satisfactory to the contracting officer, on the work at all times during progress, with authority to act for him.

**ARTICLE 9. *Delays—Damages.*** If the contractor refuses or fails to prosecute the work, or any separable part thereof, with such diligence as will insure its completion within the time specified in article 1, or any extension thereof, or fails to complete said work within such time, the Government may, by written notice to the contractor, terminate his right to proceed with the work or such part of the work as to which there has been delay. In such event the Government may take over the work and prosecute the same to completion, by contract or otherwise, and the contractor and his sureties shall be liable to the Government for any excess cost occasioned the Government thereby. If the contractor's right to proceed is so terminated, the Government may take possession of and utilize in completing the work such materials, appliances, and plant as may be on the site of the work and necessary therefor. If the Government does not terminate the right of the contractor to proceed, the contractor shall continue the work, in which event it will be impossible to determine the actual damages for the delay and in lieu thereof the contractor shall pay to the Government as fixed, agreed, and liquidated damages for each calendar day of delay until the work is completed or accepted the amount as set forth in the specifications or accompanying papers and the contractor and his sureties shall be liable for the amount thereof: *Provided*, That the right of the contractor to proceed shall not be terminated or the contractor charged with liquidated damages because of any delays in the completion of the work due to unforeseeable causes beyond the control and without the fault or negligence of the contractor, including, but not restricted to, acts of God, or of the public enemy, acts of the Government, acts of another contractor in the performance of a contract with the Government, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and unusually severe weather or delays of subcontractors due to such causes, if the contractor shall within 10 days from the beginning of any such delay (unless the contracting officer, with the approval of the head of the department or his duly authorized representative, shall grant a further period of time prior to the date of final settlement of the contract) notify the contracting officer in writing of the causes of delay, who shall ascertain the facts and the extent of the delay and extend the time for completing the work when in his judgment the findings of fact justify such an extension, and his findings of fact thereon shall be final and conclusive on the parties hereto, subject only to appeal, within 30 days, by the contractor to the head of the department concerned or his duly authorized representative, whose decision on such appeal as to the facts of delay and the extension of time for completing the work shall be final and conclusive on the parties hereto.

**ARTICLE 10. *Permits and Responsibility for Work.*** The contractor shall, without additional expense to the Government, obtain all required licenses and permits and be responsible for all damages to persons or property that occur as a result of his fault or negligence in connection with the prosecution of the work, and shall be responsible for all materials delivered and work performed until completion and final acceptance. Upon completion of the contract the work shall be delivered complete and undamaged.

**ARTICLE 11. *Eight-Hour Law—Overtime Compensation—Convict Labor.***  
(a) No laborer or mechanic doing any part of the work contemplated by

this contract, in the employ of the contractor or any subcontractor contracting for any part of said work contemplated, shall be required or permitted to work more than eight hours in any one calendar day upon such work at the site thereof, except upon the condition that compensation is paid to such laborer or mechanic in accordance with the provisions of this article. The wages of every laborer and mechanic employed by the contractor or any subcontractor engaged in the performance of this contract shall be computed on a basic day rate of eight hours per day and work in excess of eight hours per day is permitted only upon the condition that every such laborer and mechanic shall be compensated for all hours worked in excess of eight hours per day at not less than one and one-half times the basic rate of pay. For each violation of the requirements of this article a penalty of five dollars shall be imposed upon the contractor for each laborer or mechanic for every calendar day in which such employee is required or permitted to labor more than eight hours upon said work without receiving compensation computed in accordance with this article, and all penalties thus imposed shall be withheld for the use and benefit of the Government: *Provided*, That this stipulation shall be subject in all respects to the exceptions and provisions of U.S. Code, title 40, sections 321, 324, 325, 325a, and 326, relating to hours of labor and compensation for overtime.

(b) The contractor shall not employ any person undergoing sentence of imprisonment at hard labor.

ARTICLE 12. *Covenant against Contingent Fees.* The contractor warrants that he has not employed any person to solicit or secure this contract upon any agreement for a commission, percentage, brokerage, or contingent fee. Breach of this warranty shall give the Government the right to terminate the contract, or, in its discretion, to deduct from the contract price or consideration the amount of such commission, percentage, brokerage, or contingent fees. This warranty shall not apply to commissions payable by contractors upon contracts or sales secured or made through bona fide established commercial or selling agencies maintained by the contractor for the purpose of securing business.

ARTICLE 13. *Other contracts.* The Government may award other contracts for additional work, and the contractor shall fully cooperate with such other contractors and carefully fit his own work to that provided under other contracts as may be directed by the contracting officer. The contractor shall not commit or permit any act which will interfere with the performance of work by any other contractor.

ARTICLE 14. *Officials Not to Benefit.* No Member of or Delegate to Congress, or Resident Commissioner, shall be admitted to any share or part of this contract or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this contract if made with a corporation for its general benefit.

ARTICLE 15. *Disputes.* Except as otherwise specifically provided in this contract, all disputes concerning questions of fact arising under this contract shall be decided by the contracting officer subject to written appeal by the contractor within 30 days to the head of the department concerned or his duly authorized representative, whose decision shall be final and conclusive upon the parties thereto. In the meantime the contractor shall diligently proceed with the work as directed.

ARTICLE 16. *Payments to Contractors.* (a) Unless otherwise provided in the specifications, partial payments will be made as the work progresses at the end of each calendar month, or as soon thereafter as practicable, on

estimates made and approved by the contracting officer. In preparing estimates the material delivered on the site and preparatory work done may be taken into consideration.

(b) In making such partial payments there shall be retained 10 percent on the estimated amount until final completion and acceptance of all work covered by the contract: *Provided, however*, That the contracting officer, at any time after 50 percent of the work has been completed, if he finds that satisfactory progress is being made, may make any of the remaining partial payments in full: *And provided further*, That on completion and acceptance of each separate building, vessel, public work, or other division of the contract, on which the price is stated separately in the contract, payment may be made in full, including retained percentages thereon, less authorized deductions.

(c) All material and work covered by partial payments made shall thereupon become the sole property of the Government, but this provision shall not be construed as relieving the contractor from the sole responsibility for all materials and work upon which payments have been made or the restoration of any damaged work, or as a waiver of the right of the Government to require the fulfillment of all of the terms of the contract.

(d) Upon completion and acceptance of all work required hereunder, the amount due the contractor under this contract will be paid upon the presentation of a properly executed and duly certified voucher therefor, after the contractor shall have furnished the Government with a release, if required, of all claims against the Government arising under and by virtue of this contract, other than such claims, if any, as may be specifically excepted by the contractor from the operation of the release in stated amounts to be set forth therein.

ARTICLE 17. *Rate of Wages.* (In accordance with the act of August 30, 1935, 49 Stat. 1011, as amended by the act of June 15, 1940, 54 Stat. 399 (U.S. Code, title 40, secs. 276a and 276a-1), this article shall apply if the contract is in excess of \$2,000 in amount and is for the construction, alteration, and/or repair, including painting and decorating, of a public building or public work within the geographical limits of the States of the Union, the Territory of Alaska, the Territory of Hawaii, or the District of Columbia.)

(a) The contractor or his subcontractor shall pay all mechanics and laborers employed directly upon the site of the work, unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account, the full amounts accrued at time of payment, computed at wage rates not less than those stated in the specifications, regardless of any contractual relationship which may be alleged to exist between the contractor or subcontractor and such laborers and mechanics; and the scale of wages to be paid shall be posted by the contractor in a prominent and easily accessible place at the site of the work. The contracting officer shall have the right to withhold from the contractor so much of accrued payments as may be considered necessary by the contracting officer to pay to laborers and mechanics employed by the contractor or any subcontractor on the work the difference between the rates of wages required by the contract to be paid laborers and mechanics on the work and the rates of wages received by such laborers and mechanics and not refunded to the contractor, subcontractors, or their agents.

(b) In the event it is found by the contracting officer that any laborer or mechanic employed by the contractor or any subcontractor directly on



the site of the work covered by the contract has been or is being paid a rate of wages less than the rate of wages required by the contract to be paid as aforesaid, the Government may, by written notice to the contractor, terminate his right to proceed with the work or such part of the work as to which there has been a failure to pay said required wages and prosecute the work to completion by contract or otherwise, and the contractor and his sureties shall be liable to the Government for any excess costs occasioned the Government thereby.

(c) The regulations of the Secretary of Labor, referred to in article 19 hereof, allow certain "permissible deductions" from the wages required by this article to be paid.

ARTICLE 18. *Domestic Preference.* In the performance of the work covered by this contract the contractor, subcontractors, material men or suppliers shall use only such unmanufactured articles, materials, and supplies as have been mined or produced in the United States, and only such manufactured articles, materials, and supplies as have been manufactured in the United States substantially all from articles, materials, or supplies mined, produced, or manufactured, as the case may be, in the United States. The foregoing provision shall not apply to such articles, materials, or supplies of the class or kind to be used or such articles, materials, or supplies from which they are manufactured, as are not mined, produced, or manufactured, as the case may be, in the United States in sufficient and reasonably available commercial quantities and of a satisfactory quality, or to such articles, materials, or supplies as may be excepted by the head of the department under the proviso of title III, section 3, of the act of March 3, 1933, 47 Stat. 1520 (U.S. Code, title 41, sec. 10b).

ARTICLE 19. *Nonrebate of Wages.* The contractor shall comply with the regulations of the Secretary of Labor pursuant to the act of June 13, 1934, 48 Stat. 948 (U.S. Code, title 40, secs. 276b and 276c), and any amendments or modifications thereof, shall cause appropriate provisions to be inserted in subcontracts to insure compliance therewith by all subcontractors subject thereto, and shall be responsible for the submission of affidavits required of subcontractors thereunder, except as the Secretary of Labor may specifically provide for reasonable limitations, variations, tolerances, and exemptions from the requirements thereof.

ARTICLE 20. *Additional Security.* Should any surety upon any bond furnished in connection with this contract become unacceptable to the Government, or if any such surety shall fail to furnish reports as to his financial condition from time to time as requested by the Government, the contractor must promptly furnish such additional security as may be required from time to time to protect the interests of the Government or of persons supplying labor or materials in the prosecution of the work contemplated by the contract.

ARTICLE 21. *Definitions.* (a) The term "head of the department" as used herein shall mean the head or any assistant head of the executive department or independent establishment involved, and the term "his duly authorized representative" shall mean any person authorized to act for him other than the contracting officer.

(b) The term "contracting officer" as used herein shall include his duly appointed successor or his authorized representative.



## DIRECTIONS FOR PREPARATION OF CONTRACT

1. This form shall be used for every formal contract, except contracts on a cost-plus basis, for the construction or repair of public buildings or works, but its use will not be required in foreign countries.

2. There shall be no deviation from this standard contract form, except as provided for in these directions, as required or authorized by law, or as authorized by the Director of Procurement. Where interlineations, deletions, additions, or other alterations are permitted, specific notation of those made shall be entered in the blank space following the article entitled "Alterations" before signing. This article is not to be construed as general authority to deviate from the standard form. Deletion of the descriptive matter not applicable in the preamble need not be noted in the article entitled "Alterations."

3. The blank space of article 1 is intended for the insertion of a statement of the work to be done, together with place of performance, or for the enumeration of papers which contain the necessary data.

4. If it is deemed necessary to include an article on patents, the Invitation to Bidders shall so state and the following article be used:

ARTICLE ..... *Patents.* The contractor shall hold and save the Government, its officers, agents, servants, and employees, harmless from liability of any nature or kind, including costs and expenses, for or on account of any patented or unpatented invention, article, or appliance manufactured or used in the performance of this contract, including their use by the Government.

Where any patent or patents are to be excepted from the operation of this article, such exceptions will be specifically stated, by reference to the patent number, date of issue and name of patentee, in a proviso to be added to the article.

5. Where only one payment is contemplated, upon completion of the contract, all except paragraph (d) of article 16, "Payments to Contractor," must be stricken out.

6. If approval of the contract is required before it shall become binding, the following article must be added:

ARTICLE ..... *Approval.* This contract shall be subject to the written

approval of ..... and shall not be binding until so approved.

Contracts subject to approval are not valid until approved by the authority designated to approve them, and the contractor's copy will not be delivered, nor any distribution made, until such approval. All changes and deletions must have been made before the contract is forwarded for approval.

7. The number of executed copies and of certified copies, designation of disbursing officer, statement of appropriation, amount of bond, designation

of place of inspection, as well as other administrative details, shall be as directed by the department to which the contract pertains.

8. All blank spaces must be filled in or ruled out. The contract must be dated, and the bond must bear the same or subsequent date.

9. An officer of a corporation, a member of a partnership, or an agent signing for the principal, shall place his signature and title after the word "By" under the name of the principal. A contract executed by an attorney or agent on behalf of the contractor shall be accompanied by two authenticated copies of his power of attorney, or other evidence of his authority to act on behalf of the contractor.

10. If the contractor is a corporation, one of the certificates following the signatures of the parties must be executed. If the contract is signed by the secretary of the corporation, then the first certificate must be executed by some other officer of the corporation under the corporate seal, or the second certificate executed by the contracting officer. In lieu of either of the foregoing certificates there may be attached to the contract copies of so much of the records of the corporation as will show the official character and authority of the officer signing, duly certified by the secretary or assistant secretary, under the corporate seal, to be true copies.

11. The full name and business address of the contractor must be inserted, and the contract signed with his usual signature. Typewrite or print name under all signatures to contract and bond.

12. The contracting officer must fill in the citation of the act authorizing the contract as indicated at the end of the last page of the contract, or equivalent information must be furnished elsewhere in the contract.

13. The Invitation, Bid, Acceptance, and Instructions to Bidders are not to be incorporated in the contract.

14. The specifications should include a paragraph stating the amount of liquidated damages that will be paid by the contractor for each calendar day of delay, as indicated in article 9 of the contract. If time is not of the essence of the contract the words "No liquidated damages" or an equivalent phrase should be inserted on the reverse side of Standard Form No. 20. So much of the language in article 9 as relates to liquidated damages shall then be deleted.

15. Additional contract provisions and instructions, deemed necessary for the particular work, not inconsistent with the standard forms nor involving questions of policy, may be incorporated in the specifications or other accompanying papers.

**THE STANDARD FORM OF CONSTRUCTION CONTRACT  
ISSUED BY THE  
AMERICAN RAILWAY ENGINEERING ASSOCIATION  
FOR LUMP-SUM AND UNIT-PRICE CONTRACTS  
1947**

THIS CONTRACT, made this ..... day of ....., 19....., by and between ..... a corporation organized and existing under the laws of the State of ....., hereinafter called the ..... Company, and ....., hereinafter called the Contractor.

WITNESSETH: That, in consideration of the covenants and agreements herein contained, to be performed by the parties hereto, and of the payments hereinafter agreed to be made, it is mutually agreed as follows:

The Contractor shall furnish all of the materials, superintendence, labor, tools, equipment and transportation, except as hereinafter specified, and shall execute, construct and finish, in an expeditious, substantial and workmanlike manner, to the satisfaction and acceptance of the Chief Engineer of the Company, all of the work required for .....  
 ....., in accordance with the plans identified by the signatures of the Contractor and the Chief Engineer, dated ....., 19....., and described .....  
 ....., and the Specifications hereto attached, all of which are made a part of this contract.

The work covered by this contract shall be commenced on or before the ..... day of ....., 19....., and shall be completed on or before the ..... day of ....., 19.....

[For those desiring a liquidating damage clause the following reading is suggested for insertion at this point, as given in Note 1.]

[For those who believe that a so-called "bonus" cause not only strengthens the "liquidated damages" clause, but is also an urge to the Contractor for early completion, as well as being fair and equitable, the following reading is suggested at this point, as given in Note 2.]

And in consideration of the completion of the work described herein, and the fulfillment of all stipulations of this contract to the satisfaction and acceptance of the Chief Engineer of the Company, the Company shall pay, or cause to be paid, to the Contractor, the amount due to the Contractor, based on the following prices:

[Here insert a schedule of Items and Prices.]

## 1. TERMS OF EMPLOYMENT

The Company reserves no control whatsoever over the employment, discharge, compensation of or services rendered by the Contractor's employees, and it is the intention of the parties to this agreement that the Contractor shall be and remain an Independent Contractor, and that nothing in this agreement contained shall be construed as inconsistent with that status. The Contractor agrees to pay the contributions measured by the wages of his (its) employees required to be made under the Unemployment Compensation Insurance, Social Security and Retirement Laws or similar laws, State and Federal, applicable to the work hereunder undertaken by the Contractor or his (its) subcontractors, and to accept exclusive liability for said contributions; the Contractor further promises and agrees to indemnify and hold harmless the Company, its successors and assigns, from any and all liability arising therefrom.

## 2. INTENT OF PLANS AND SPECIFICATIONS

All work that may be called for in the specifications and not shown on the plans, or shown on the plans and not called for in the specifications, shall be executed and furnished by the Contractor as if described in both these ways; and should any work or material be required which is not detailed in the specifications or plans, either directly or indirectly but which

is nevertheless necessary for the proper carrying out of the intent thereof, the Contractor is to understand the same to be implied and required, and shall perform all such work and furnish any such material as fully as if they were particularly delineated or described.

### 3. CONTRACTOR'S UNDERSTANDING

It is understood and agreed that the Contractor has, by careful examination, satisfied himself as to the nature and location of the work, the conformation of the ground, the character, quality and quantity of the materials to be encountered, the character of equipment and facilities needed preliminary to and during the prosecution of the work, the general and local conditions, and all other matters which can in any way affect the work under this contract. No verbal agreement or conversation with any officer, agent or employee of the Company, either before or after the execution of this contract, shall affect or modify any of the terms or obligations herein contained.

### 4. LAND OF COMPANY, USE OF, BY CONTRACTOR

The Company shall provide the land upon which the work under this contract is to be done, and will, so far as it can conveniently do so, permit the Contractor to use so much of its land as is required for the erection of temporary construction facilities and storage of materials, together with the right of access to same, but beyond this, the Contractor shall provide, at his cost and expense, any additional land required.

### 5. CONSENT TO TRANSFER

The Contractor shall not let, transfer or assign this contract as a whole, without the consent in writing from the Company. Parts or portions of the work and the furnishing of and delivery of materials may be subcontracted with the consent of the Chief Engineer, but such consent does not relieve the Contractor from any of his obligations and liabilities under the contract.

### 6. RISK

The work under this contract in every respect shall be at the risk of the Contractor until finished and accepted, except damage or injury caused directly by Company's agents or employees.

### 7. ENGINEER AND CHIEF ENGINEER

Wherever in this contract the word Engineer is used, it shall be understood as referring to the Chief Engineer of the Company, acting personally or through an assistant duly authorized in writing for such act by the Chief Engineer, and wherever the words Chief Engineer are used it shall be understood as referring to the Chief Engineer in person, and not to any assistant engineer.

### 8. WAIVER

It is expressly understood and agreed that any waiver on the part of the Company or the Engineer, of any term, provision or covenant of this contract, shall not constitute a precedent, nor bind the Company or the Engineer, to a waiver of any succeeding breach of the same or any other of the terms, provisions or covenants of this contract.

## 9. ADJUSTMENT OF DISPUTE

All questions or controversies which may arise between the Contractor and the Company, under or in reference to this contract, shall be subject to the decision of the Chief Engineer, and his decision shall be final and conclusive upon both parties.

## 10. BOND

The Contractor unless notified to the contrary, shall, at the time of the execution and delivery of this contract, and before the taking effect of the same in other respects, furnish and deliver to the Company a written bond of indemnity to the amount of ..... dollars in form and substance and with surety thereon satisfactory and acceptable to the Company, to insure the faithful performance by the Contractor of all the covenants and agreements on the part of the Contractor contained in this contract.

This bond shall remain in force and effect for the full amount or such smaller sum as may at any time be specified by the Chief Engineer.

## 11. PERMITS AND INSURANCE

Before doing any work under this contract the Contractor at his (its) own expense shall secure and keep in effect until the entire work is completed and accepted the following items:

(a) All permits, licenses and authorizations of a temporary nature required by Federal, State, County or Municipal authorities and assume payment of salaries and expenses of city and other public inspectors, policemen or officers which may be required in connection therewith. (Permits for permanent structures will be secured and paid for by the Company.)

(b) Fire insurance in the name of and payable to the Company for the benefit of the Contractor or the Company as the Chief Engineer shall find their interests to appear. Such policies to cover such structures or structural material and supplies on hand and subject to damage as a result of fire, in such amount as necessary to cover their value.

(c) Workmen's Compensation insurance covering employees of the Contractor or any subcontractor, as required by the State or States in which the work is to be performed, so that the Company shall be duly protected from any liability or claims for damages for personal injury, including death, which may arise while engaged upon the work covered by this contract. The Contractor shall submit to the Chief Engineer evidence by certificate that such insurance in satisfactory amount is in force.

(d) Public Liability Insurance Standard, Intermediate or Full Coverage, whichever form of coverage the Chief Engineer designates, shall be furnished in amounts of \$....., \$....., and Property Damage insurance in amount of \$.....

(e) Contractor's Contingent Public Liability and Property Damage insurance, if there are one or more subcontractors, in the same amounts as required in (d) above.

Policies required in (d) and (e) shall be endorsed to cover the collapse and explosion hazard in addition to all other hazards unless endorsement be waived by the Chief Engineer, and shall expressly provide that

if during the course of this work watchmen, flagmen or other employees of the Company are loaned or assigned to the Contractor to perform work in connection with the work under this contract, such employees, while so engaged, shall be considered employees of the Contractor for the purpose of this insurance.

All the policies must be written by reliable and well-rated companies acceptable to the Chief Engineer. The policies shall be so written that they protect both the Contractor and the Company against any action which may be instituted against either of them. Certified copies of all policies shall be submitted to the Chief Engineer for approval. When approved they shall be retained by the Company and the Contractor notified of their approval.

## 12. INDEMNITY

The Contractor shall indemnify and save harmless the Company from and against all losses and all claims, demands, payments, suits, actions, recoveries and judgments of every nature and description made, brought or recovered against the Company by reason of any act or omission of the Contractor, his agents or employees, in the execution of the work or in guarding the same.

In case no bond is furnished the Company may require indemnity insurance in amount, form and substance, satisfactory and acceptable to the Company, which insurance shall provide for the protection of the Company against failure of the Contractor to comply with the conditions of this covenant. The Contractor shall take out and pay the premiums on such insurance.

## 13. SUPERINTENDENCE

The Contractor shall constantly superintend all of the work embraced in this contract, in person or by a duly authorized representative acceptable to the Company.

## 14. NOTICE—HOW SERVED

Any notice to be given by the Company to the Contractor under this contract shall be deemed to be served if the same be delivered to the person in charge of the office used by the Contractor, or to his representative at or near the work, or deposited in the postoffice, postpaid, addressed to the Contractor at his last known place of business.

## 15. PROTECTION

Whenever the local conditions, laws or ordinances require, the Contractor shall furnish and maintain, at his own cost and expense, necessary passageways, guard fences and lights and such other facilities and means of protection as may be required.

## 16. TIMELY DEMAND FOR POINTS AND INSTRUCTIONS

The Contractor shall provide reasonable and necessary opportunities and facilities for setting points and making measurements. He shall not proceed until he has made timely demand upon the Engineer for, and has received from him, such points and instructions as may be necessary as the work progresses. The work shall be done in strict conformity with such points and instructions.



### 17. PRESERVATION OF STAKES

The Contractor shall carefully preserve bench marks, reference points and stakes, and in case of wilful or careless destruction, he will be charged with the resulting expense and shall be responsible for any mistakes that may be caused by their unnecessary loss or disturbance.

### 18. REPORT ERRORS AND DISCREPANCIES

If the Contractor, in the course of the work, finds any discrepancy between the plans and the physical conditions of the locality, or any errors or omissions in plans or in the layout as given by points and instructions, it shall be his duty to immediately inform the Engineer, in writing, and the Engineer shall promptly verify the same. Any work done after such discovery, until authorized, will be done at the Contractor's risk.

### 19. INSPECTION

All work and material shall be at all times open to the inspection, acceptance or rejection of the Engineer or his authorized representative. The Contractor shall give the Engineer reasonable notice of starting any new work and shall provide reasonable and necessary facilities for inspection even to the extent of taking out portions of finished work; in case the work is found satisfactory, the cost of taking out and replacement shall be paid by the Company. No work shall be done at night without the previous approval of the Engineer.

### 20. DEFECTIVE WORK OR MATERIAL

The Engineer shall have power to reject or condemn all work or material which does not conform to this contract and any omission or failure on the part of the Engineer to disapprove or reject any defective work or material shall not be construed to be an acceptance thereof.

The Contractor shall remove, at his own expense, any work or material condemned by the Engineer, and shall rebuild and replace the same without extra charge, and in default thereof the same may be done by the Company at the Contractor's expense, or in case the Chief Engineer shall not consider the defect of sufficient importance to require the Contractor to rebuild or replace any imperfect work or material, he shall have power and is hereby authorized to make an equitable deduction from the stipulated price established under the terms of this agreement.

### 21. CHANGE OF FACILITIES OF OTHER UTILITIES

If in the conduct of the contemplated work any temporary changes or alterations in water, oil or gas pipe lines, sewers, drains, conduits, fences, trolley tracks, electric line or power lines, telephone or telegraph or other wires, poles, etc., are necessary, either for the convenience of the Contractor or for the performance of the work, the responsibility for making such changes will rest with the Contractor unless otherwise provided elsewhere in this agreement; and he shall arrange for such changes to be made at his own expense.

If such changes are of a permanent character and made necessary by the improvement itself and not incident to the performance of the work, then in that case such changes will be arranged for by the Company or others without cost to the Contractor.

## 22. WORK ADJACENT TO RAILWAY OR OTHER PROPERTY

Wherever the work embraced in this contract is near the tracks, structures or buildings of the Company or of other railways, or persons, the Contractor shall use proper care and vigilance to avoid injury to persons or property. The work shall be so conducted as not to interfere with the movement of trains or other operations of the railway; or, if in any case such interference be necessary, the Contractor shall not proceed until he has first obtained specific authority and directions therefor from the proper designated officer of the Company and has the approval of the Engineer.

## 23. RIGHTS OF VARIOUS INTERESTS

Wherever work being done by Company forces or by other contractors is contiguous to work covered by this contract, the respective rights of the various interests involved shall be established by the Engineer, to secure the completion of the various portions of the work in general harmony.

## 24. CONTRACTOR NOT TO HIRE COMPANY'S EMPLOYEES

The Contractor shall not employ or hire any of the Company's employees without the permission of the Engineer.

## 25. ORDER OF COMPLETION; USE OF COMPLETED PORTIONS

The Contractor shall complete any portion or portions of the work in such order of time as the Engineer may require. The Company shall have the right to take possession of and use any completed or partially completed portions of the work, notwithstanding the time for completing the entire work or such portions may not have expired; but such taking possession and use shall not be deemed an acceptance of the work so taken or used or any part thereof. If such prior use increases the cost of or delays the work, the Contractor shall be entitled to such extra compensation, or extension of time, or both, as the Chief Engineer may determine.

## 26. CHANGES

The Company shall have the right to make any changes that may be hereafter determined upon, in the nature or dimensions of the work, either before or after its commencement, and such changes shall in no way affect or void the obligations of this contract. If such changes make any change in the cost of the work, an equitable adjustment shall be made by the Chief Engineer to cover the same, but the Contractor shall not claim compensation for anticipated profits.

## 27. EXTRA WORK

(a) No bill or claim for extra work or material shall be allowed or paid unless the doing of such extra work or the furnishing of such extra material shall have been authorized in writing by the ..... Engineer.

(b) The price for such work shall be determined by the Chief Engineer, who may either fix a unit price or a lump sum price, or may, if he so elects, provide that the price shall be determined by the actual cost, to which shall be added ..... percent to cover general expenses and superintendence, profits, contingencies, use of tools, Contractor's risk and liability. If the Contractor shall perform any work or furnish any material which is not provided in this contract, or which was not authorized in writing by

the Engineer, said Contractor shall receive no compensation for such work or materials so furnished, and does hereby release and discharge the Company from any liability therefor.

(c) If the Contractor shall proceed with such extra work or the furnishing of such extra material after receiving the written authority therefor, as hereinbefore provided, then such work or material, stated in the written authority of the Engineer, shall be covered, governed and controlled by all the terms and provisions of this contract, subject to such prices as may be agreed upon or fixed by the Chief Engineer.

(d) If the Contractor shall decline or fail to perform such work or furnish such extra material as authorized by the Engineer in writing, as aforesaid, the Company may then arrange for the performance of the work in any manner it may see fit, the same as if this contract had not been executed, and the Contractor shall not interfere with such performance of the work.

## 28. UNAVOIDABLE DELAYS: EXTENSION OF TIME ON PARTS OF WORK

If the Contractor shall be delayed in the performance of the work from any cause beyond his control, he may, upon written application to the Chief Engineer within three days of such delay, be granted such extension of time as the Chief Engineer shall deem equitable and just.

## 29. SUSPENSION OF WORK

The Company may at any time stop the work, or any part thereof, by giving ..... days' notice to the Contractor in writing. The work shall be resumed by the Contractor within ten days after the date fixed in the written notice from the Company to the Contractor so to do. The Company shall not be held liable for any damages or anticipated profits on account of the work being stopped, or for any work done during the interval of suspension. It will, however, pay the Contractor for expense of men and teams necessarily retained during the interval of suspension; provided the Contractor can show that it was not reasonably practical to move these men and teams to other points at which they could have been employed. The Company will further pay the Contractor for time necessarily lost during such suspension at the rate of ..... percent per annum on the estimated value of materials, equipment and fixtures furnished by the Contractor on the work which is necessarily idle during such suspension, said rate of ..... percent per annum being understood to include depreciation, interest and insurance. But if the work, or any part thereof, shall be stopped by the notice in writing aforesaid, and if the Company does not give notice in writing to the Contractor to resume work at a date within ..... of the date fixed in the written notice to suspend, then the Contractor may abandon that portion of the work so suspended and he will be entitled to the estimates and payments for work done on such portion so abandoned, as provided in Section 38 of this contract.

## 30. FAILURE OF PERFORMANCE BY CONTRACTOR

(a) If the Chief Engineer of the Company shall at any time be of the opinion that the Contractor is neglecting to remedy any imperfection in

the work, or is not progressing with the work as fast as necessary to insure its completion within the time and as required by the contract, or is otherwise violating any of the provisions of this contract, the Chief Engineer, in behalf of the Company, shall have the power, and it shall be his duty to notify the Contractor in writing to remedy such imperfections, proceed more rapidly with said work, or otherwise comply with the provisions of this contract.

(b) If on the expiration of ten days after the serving of such written notice upon the Contractor, the Contractor shall continue to neglect the work and shall fail to satisfy the Engineer of his efforts, ability and intentions, to remedy the specified deficiencies, the Company may terminate the employment of the Contractor and may take possession of the work and of all materials, tools and appliances thereon, and employ such means as may be, in the Engineer's judgment, necessary to finish the work. In such case the Contractor shall receive no further payment until the work shall be finished, when, if the unpaid balance that would be due under this contract exceeds the cost to the Company of finishing the work, such excess shall be paid to the Contractor; but if such cost exceeds such unpaid balance, the Contractor shall pay the difference to the Company.

(c) Upon failure of the Contractor to comply with any notice given in accordance with the provisions thereof, the Company shall have the alternative right, instead of assuming charge of the entire work, to place additional forces, tools, equipment and materials on parts of the work for the purpose of carrying on such parts of the work, and the Contractor shall be allowed therefor the contract price. The Company may retain the amount of the cost of such work, with ..... percent added, from any sum or sums due or to become due the Contractor under this contract.

### 31. ANNULMENT WITHOUT FAULT OF CONTRACTOR

The Company shall have the right at any time, for reasons which appear good to it, to annul this contract upon giving notice in writing to the Contractor, in which event the Contractor shall be entitled to the full amount of the estimate for the work done by him under this contract up to the time of such annulment, including the retained percentage. The Contractor shall be reimbursed by the Company for such expenditures as in the judgment of the Chief Engineer are not otherwise compensated for, and as are required in preparing for and moving to and from the work; the intent being that an equitable settlement shall be made with the Contractor.

### 32. REMOVAL OF EQUIPMENT

In case of annulment of this contract before completion from any cause whatever, the Contractor, if notified to do so by the Company, shall promptly remove any part or all of his equipment and supplies from the property of the Company, failing which the Company shall have the right to move such equipment and supplies at the expense of the Contractor.

### 33. FAILURE TO MAKE PAYMENTS

Failure by the Company to make payments at the times provided by this contract shall give the Contractor the right to suspend work until payment is made, or at his option, after thirty days' notice in writing, should the Company continue to default, to terminate this contract and recover the price

of all work done and materials provided and all damages sustained, and such failure to make payments at the time provided shall be a bar to any claim by the Company against the Contractor for delay in completion of the work, due to such suspension or failure to pay.

#### 34. LIENS

If at any time there shall be evidence of any lien or claim for which the Company might become liable, and which is chargeable to the Contractor, the Company shall have the right to retain out of any payment then due or thereafter to become due, an amount sufficient to completely indemnify the Company against such lien or claim, and if such lien or claim be valid, the Company may pay and discharge the same, and deduct the amount so paid from any moneys which may be or become due and payable to the Contractor.

#### 35. MONTHLY ESTIMATE

So long as the work herein contracted for is prosecuted in accordance with the provisions of this contract, and with such progress as may be satisfactory to the Chief Engineer, the said Chief Engineer will, on or about the first day of each month, make an approximate estimate of the proportionate value of the work done and of acceptable material furnished or delivered upon the Company's property at the site of the work, up to and including the last day of the previous month. The amount of said estimate after deducting ..... percent and all previous payments, shall be due and payable to the Contractor at the office of the Treasurer of the Company on or before the ..... day of the current month.

It is understood and agreed that the monthly estimates and certificates on unfinished work shall, in no case, be taken as an acceptance of the work, or a release of the Contractor from responsibility therefor, and that in computing the final estimate the Chief Engineer need not be bound by the preceding estimates and certificates.

#### 36. CLEANING UP

The Contractor shall, as directed by the Engineer, remove from the Company's property and from all public and private property, at his own expense, all temporary structures, rubbish and waste materials, resulting from his operations.

#### 37. ACCEPTANCE

The work shall be inspected for acceptance by the Company promptly upon receipt of notice in writing that the work is ready for such inspection.

#### 38. FINAL ESTIMATE

Upon the completion and acceptance of the work, the Chief Engineer shall issue a final estimate over his signature, covering work provided for in this contract, completed and accepted by him, under the terms and conditions thereof, whereupon the balance found to be due the Contractor, including the retained percentage, shall be paid to the Contractor at the office of the Treasurer of the Company within ..... days after the date of said final estimate, provided that, before the payment of said final estimate,

the Contractor shall submit evidence satisfactory to the Chief Engineer that all payrolls, material bills and outstanding indebtedness in connection with the work have been paid.

THIS CONTRACT shall inure to the benefit of and be binding upon the legal representatives and successors of the parties respectively.

IN WITNESS WHEREOF, the parties hereto have executed this contract, in \_\_\_\_\_, the day and year first above written.

\_\_\_\_\_ Company,

Attest: By \_\_\_\_\_

\_\_\_\_\_  
Secretary.

\_\_\_\_\_  
Contractor.

Witness: By \_\_\_\_\_

\_\_\_\_\_

*Note 1.* And, whereas, time being the essence of this contract and it is agreed that the Company would suffer loss by the failure of the Contractor to have said work completed in all its parts on said day, and as it might be difficult and expensive to accurately compute the amount of such loss; in order to avoid such expense and difficulty, the Contractor hereby expressly covenants and agrees to pay to the Company the sum of \_\_\_\_\_ Dollars per day for each and every day, Sundays and legal holidays only excepted, after said \_\_\_\_\_ day of \_\_\_\_\_, 19\_\_\_\_\_, during or upon which the said work or any part thereof remains incomplete and unfinished, not as a penalty, but as the liquidated actual losses which the Company will suffer on account of any failure on the part of the Contractor to have said work completed in all of its parts on said day; and that any sum which may be due the Company for such losses may be deducted and retained by the Company from any balance which may be due the Contractor when the said work shall have been finished and accepted as hereinafter provided. It is, however, agreed that in case any failure to complete the said work or some part thereof on said day shall be due to any cause beyond the Contractor's control and for which the Chief Engineer has granted an extension of time, such delays form no part of the number of days for each and every one of which the Contractor is to pay the Company the sum of \_\_\_\_\_ Dollars as herein specified.

*Note 2.* If the work is completed by the Contractor prior to the date herein given, then the Company agrees to pay the Contractor an equal amount as given for each day said completed work is available for use by the Company as determined by its Engineer.

# THE STANDARD FORM OF AGREEMENT BETWEEN CONTRACTOR AND OWNER FOR CONSTRUCTION OF BUILDINGS

ISSUED BY THE AMERICAN INSTITUTE OF ARCHITECTS  
FOR USE WHEN A STIPULATED SUM FORMS  
THE BASIS OF PAYMENT

This form of agreement, fifth edition, has received the approval of the associated general contractors of America; the Contracting Plasterers' International Association; the Heating, Piping and Air Conditioning Contractors National Association; the National Building Granite Quarries Association, Inc.; the National Electrical Contractors Association; the Painting and Decorating Contractors of America, and the Producers' Council, Inc.

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This form is to be used only with the standard general conditions of the contract for construction of buildings.

THIS AGREEMENT made the ..... day of ..... in the  
year Nineteen Hundred and ..... by and between .....  
..... hereinafter called the Contractor, and .....

..... hereinafter called the Owner,  
WITNESSETH, that the Contractor and the Owner for the considerations hereinafter named agree as follows:

ARTICLE 1. *Scope of the Work.* The Contractor shall furnish all of the materials and perform all of the work shown on the Drawings and described in the Specifications entitled

[Here insert the caption descriptive of the work as used on the Drawings and in the other Contract Documents.]

prepared by .....  
acting as and in these Contract Documents entitled the Architect; and shall do everything required by this Agreement, the General Conditions of the Contract, the Specifications and the Drawings.

ARTICLE 2. *Time of Completion.* The work to be performed under this Contract shall be commenced ..... and shall be substantially

completed .....  
 [Here insert stipulation as to liquidated damages, if any.]

**ARTICLE 3. *The Contract Sum.*** The Owner shall pay the Contractor for the performance of the Contract, subject to additions and deductions provided therein, in current funds as follows: .....

[State here the lump sum amount, unit prices, or both, as desired in individual cases.]

Where the quantities originally contemplated are so changed that application of the agreed unit price to the quantity of work performed is shown to create a hardship to the Owner or the Contractor, there shall be an equitable adjustment of the Contract to prevent such hardship.

**ARTICLE 4. *Progress Payments.*** The Owner shall make payments on account of the Contract as provided therein, as follows:

On or about the ..... day of each month .....  
 per cent of the value, based on the Contract prices, of labor and materials incorporated in the work and of materials suitably stored at the site thereof up to the ..... day of that month, as estimated by the Architect, less the aggregate of previous payments; and upon substantial completion of the entire work, a sum sufficient to increase the total payments to ..... per cent of the Contract price .....

[Insert here any provision made for limiting or reducing the amount retained after the work reaches a certain stage of completion.]

**ARTICLE 5. *Acceptance and Final Payment.*** Final payment shall be due

..... days after substantial completion of the work provided the work be then fully completed and the Contract fully performed.

Upon receipt of written notice that the work is ready for final inspection and acceptance, the Architect shall promptly make such inspection, and when he finds the work acceptable under the Contract and the Contract fully performed he shall promptly issue a final certificate, over his own signature, stating that the work provided for in this Contract has been completed and is accepted by him under the terms and conditions thereof, and that the entire balance found to be due the Contractor, and noted in said final certificate, is due and payable.

Before issuance of final certificate the Contractor shall submit evidence satisfactory to the Architect that all payrolls, material bills, and other indebtedness connected with the work have been paid.



If after the work has been substantially completed, full completion thereof is materially delayed through no fault of the Contractor, and the Architect so certifies, the Owner shall, upon certificate of the Architect, and without terminating the Contract, make payment of the balance due for that portion of the work fully completed and accepted. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

ARTICLE 6. *The Contract Documents.* The General Conditions of the Contract, the Specifications and the Drawings, together with this Agreement, form the Contract, and they are as fully a part of the Contract as if hereto attached or herein repeated. The following is an enumeration of the Specifications and Drawings:

IN WITNESS WHEREOF the parties hereto have executed this Agreement, the day and year first above written.

[Signatures and Affidavits]

## THE GENERAL CONDITIONS OF THE CONTRACT FOR THE CONSTRUCTION OF BUILDINGS

### STANDARD FORM OF THE AMERICAN INSTITUTE OF ARCHITECTS

THIS STANDARD FORM OF GENERAL CONDITIONS, FIFTH EDITION, HAS RECEIVED THE APPROVAL OF THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA; THE CONTRACTING PLASTERERS' INTERNATIONAL ASSOCIATION; THE HEATING, PIPING AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION; THE NATIONAL BUILDING GRANITE QUARRIES ASSOCIATION, INC.; THE NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION; THE PAINTING AND DECORATING CONTRACTORS OF AMERICA, AND THE PRODUCERS' COUNCIL, INC.

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ARTICLE 1. *Definitions.*

(a) The Contract Documents consist of the Agreement, the General Conditions of the Contract, the Drawings and Specifications, including all modifications thereof incorporated in the documents before their execution. These form the Contract.

(b) The Owner, the Contractor and the Architect are those mentioned as such in the Agreement. They are treated throughout the Contract Documents as if each were of the singular number and masculine gender.

(c) The term Subcontractor, as employed herein, includes only those having a direct contract with the Contractor and it includes one who furnishes material worked to a special design according to the plans or specifications of this work, but does not include one who merely furnishes material not so worked.

(d) Written notice shall be deemed to have been duly served if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered at or sent by registered mail to the last business address known to him who gives the notice.

(e) The term "work" of the Contractor or Subcontractor includes labor or materials or both.

(f) All time limits stated in the Contract Documents are of the essence of the Contract.

(g) The law of the place of building shall govern the construction of this Contract.

**ARTICLE 2. *Execution, Correlation and Intent of Documents.*** The Contract Documents shall be signed in duplicate by the Owner and the Contractor. In case the Owner and the Contractor fail to sign the General Conditions, Drawings or Specifications, the Architect shall identify them.

The Contract Documents are complementary, and what is called for by any one shall be as binding as if called for by all. The intention of the documents is to include all labor and materials, equipment and transportation necessary for the proper execution of the work. It is not intended, however, that materials or work not covered by or properly inferable from any heading, branch, class or trade of the specifications shall be supplied unless distinctly so noted on the drawings. Materials or work described in words which so applied have a well-known technical or trade meaning shall be held to refer to such recognized standards.

**ARTICLE 3. *Detail Drawings and Instructions.*** The Architect shall furnish with reasonable promptness, additional instructions, by means of drawings or otherwise, necessary for the proper execution of the work. All such drawings and instructions shall be consistent with the Contract Documents, true developments thereof, and reasonably inferable therefrom.

The work shall be executed in conformity therewith and the Contractor shall do no work without proper drawings and instructions.

The Contractor and the Architect, if either so requests, shall jointly prepare a schedule, subject to change from time to time in accordance with the progress of the work, fixing the dates at which the various detail drawings will be required, and the Architect shall furnish them in accordance with that schedule. Under like conditions, a schedule shall be prepared, fixing the dates for the submission of shop drawings, for the beginning of manufacture and installation of materials and for the completion of the various parts of the work.

**ARTICLE 4. *Copies Furnished.*** Unless otherwise provided in the Contract Documents the Architect will furnish to the Contractor, free of charge, all copies of drawings and specifications reasonably necessary for the execution of the work.

**ARTICLE 5. *Shop Drawings.*** The Contractor shall submit with such promptness as to cause no delay in his own work or in that of any other Contractor, two copies of all shop or setting drawings and schedules required for the work of the various trades, and the Architect shall pass upon them with reasonable promptness, making desired corrections, including all necessary corrections relating to artistic effect. The Contractor shall make any corrections required by the Architect, file with him two corrected copies and furnish such other copies as may be needed. The Architect's approval of such drawings or schedules shall not relieve the Contractor from responsibility for deviations from drawings or specifications, unless he has in writing called the Architect's attention to such deviations at the time of submission, nor shall it relieve him from responsibility for errors of any sort in shop drawings or schedules.

**ARTICLE 6. *Drawings and Specifications on the Work.*** The Contractor shall keep one copy of all drawings and specifications on the work, in good order, available to the Architect and to his representatives.

ARTICLE 7. *Ownership of Drawings and Models.* All drawings, specifications and copies thereof furnished by the Architect are his property. They are not to be used on other work and, with the exception of the signed Contract set, are to be returned to him on request, at the completion of the work. All models are the property of the Owner.

ARTICLE 8. *Samples.* The Contractor shall furnish for approval all samples as directed. The work shall be in accordance with approved samples.

ARTICLE 9. *Materials, Appliances, Employees.* Unless otherwise stipulated, the Contractor shall provide and pay for all materials, labor, water, tools, equipment, light, power, transportation and other facilities necessary for the execution and completion of the work.

Unless otherwise specified, all materials shall be new and both workmanship and materials shall be of good quality. The Contractor shall, if required, furnish satisfactory evidence as to the kind and quality of materials.

The Contractor shall at all times enforce strict discipline and good order among his employees, and shall not employ on the work any unfit person or any one not skilled in the work assigned to him.

ARTICLE 10. *Royalties and Patents.* The Contractor shall pay all royalties and license fees. He shall defend all suits or claims for infringement of any patent rights and shall save the Owner harmless from loss on account thereof, except that the Owner shall be responsible for all such loss when a particular process or the product of a particular manufacturer or manufacturers is specified, but if the Contractor has information that the process or article specified is an infringement of a patent he shall be responsible for such loss unless he promptly gives such information to the Architect or Owner.

ARTICLE 11. *Surveys, Permits and Regulations.* The Owner shall furnish all surveys unless otherwise specified. Permits and licenses of a temporary nature necessary for the prosecution of the work shall be secured and paid for by the Contractor. Permits, licenses and easements for permanent structures or permanent changes in existing facilities shall be secured and paid for by the Owner, unless otherwise specified.

The Contractor shall give all notices and comply with all laws, ordinances, rules and regulations bearing on the conduct of the work as drawn and specified. If the Contractor observes that the drawings and specifications are at variance therewith, he shall promptly notify the Architect in writing, and any necessary changes shall be adjusted as provided in the Contract for changes in the work. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, rules and regulations, and without such notice to the Architect, he shall bear all costs arising therefrom.

ARTICLE 12. *Protection of Work and Property.* The Contractor shall continuously maintain adequate protection of all his work from damage and shall protect the Owner's property from injury or loss arising in connection with this Contract. He shall make good any such damage, injury or loss, except such as may be directly due to errors in the Contract Documents or caused by agents or employees of the Owner. He shall adequately protect adjacent property as provided by law and the Contract Documents.

The Contractor shall take all necessary precautions for the safety of employees on the work, and shall comply with all applicable provisions of Federal, State, and Municipal safety laws and building codes to prevent accidents or injury to persons on, about or adjacent to the premises where the work is being performed. He shall erect and properly maintain at all times, as required by the conditions and progress of the work, all necessary

safeguards for the protection of workmen and the public and shall post danger signs warning against the hazards created by such features of construction as protruding nails, hod hoists, well holes, elevator hatchways, scaffolding, window openings, stairways and falling materials; and he shall designate a responsible member of his organization on the work, whose duty shall be the prevention of accidents. The name and position of the person so designated shall be reported to the Architect by the Contractor.

In an emergency affecting the safety of life or of the work or of adjoining property, the Contractor, without special instruction or authorization from the Architect or Owner, is hereby permitted to act, at his discretion, to prevent such threatened loss or injury, and he shall so act, without appeal, if so instructed or authorized. Any compensation, claimed by the Contractor on account of emergency work, shall be determined by agreement or Arbitration.

**ARTICLE 13. *Inspection of Work.*** The Architect and his representatives shall at all times have access to the work wherever it is in preparation or progress and the Contractor shall provide proper facilities for such access and for inspection.

If the specifications, the Architect's instructions, laws, ordinances or any public authority require any work to be specially tested or approved, the Contractor shall give the Architect timely notice of its readiness for inspection, and if the inspection is by another authority than the Architect, of the date fixed for such inspection. Inspections by the Architect shall be promptly made, and where practicable at the source of supply. If any work should be covered up without approval or consent of the Architect, it must, if required by the Architect, be uncovered for examination at the Contractor's expense.

Re-examination of questioned work may be ordered by the Architect and if so ordered the work must be uncovered by the Contractor. If such work be found in accordance with the Contract Documents the Owner shall pay the cost of re-examination and replacement. If such work be found not in accordance with the Contract Documents the Contractor shall pay such cost, unless he shall show that the defect in the work was caused by another Contractor, and in that event the Owner shall pay such cost.

**ARTICLE 14. *Superintendence: Supervision.*** The Contractor shall keep on his work, during its progress, a competent superintendent and any necessary assistants, all satisfactory to the Architect. The superintendent shall not be changed except with the consent of the Architect, unless the superintendent proves to be unsatisfactory to the Contractor and ceases to be in his employ. The superintendent shall represent the Contractor in his absence and all directions given to him shall be as binding as if given to the Contractor. Important directions shall be confirmed in writing to the Contractor. Other directions shall be so confirmed on written request in each case.

The Contractor shall give efficient supervision to the work, using his best skill and attention. He shall carefully study and compare all drawings, specifications and other instructions and shall at once report to the Architect any error, inconsistency or omission which he may discover, but he shall not be held responsible for their existence or discovery.

**ARTICLE 15. *Changes in the Work.*** The Owner, without invalidating the Contract, may order extra work or make changes by altering, adding to or deducting from the work, the Contract Sum being adjusted accordingly. All such work shall be executed under the conditions of the original con-

tract except that any claim for extension of time caused thereby shall be adjusted at the time of ordering such change.

In giving instructions, the Architect shall have authority to make minor changes in the work, not involving extra cost, and not inconsistent with the purposes of the building, but otherwise, except in an emergency endangering life or property, no extra work or change shall be made unless in pursuance of a written order from the Owner signed or countersigned by the Architect, or a written order from the Architect stating that the Owner has authorized the extra work or change, and no claim for an addition to the contract sum shall be valid unless so ordered.

The value of any such extra work or change shall be determined in one or more of the following ways:

- (a) By estimate and acceptance in a lump sum.
- (b) By unit prices named in the contract or subsequently agreed upon.
- (c) By cost and percentage or by cost and a fixed fee.

If none of the above methods is agreed upon, the Contractor, provided he receives an order as above, shall proceed with the work. In such case and also under case (c) he shall keep and present in such form as the Architect may direct, a correct account of the cost, together with vouchers. In any case, the Architect shall certify to the amount, including reasonable allowance for overhead and profit, due to the Contractor. Pending final determination of value, payments on account of changes shall be made on the Architect's certificate.

Should conditions encountered below the surface of the ground be at variance with the conditions indicated by the drawings and specifications the contract sum shall be equitably adjusted upon claim by either party made within a reasonable time after the first observance of the conditions.

**ARTICLE 16. *Claims for Extra Cost.*** If the Contractor claims that any instructions by drawings or otherwise involve extra cost under this contract, he shall give the Architect written notice thereof within a reasonable time after the receipt of such instructions, and in any event before proceeding to execute the work, except in emergency endangering life or property, and the procedure shall then be as provided for changes in the work. No such claim shall be valid unless so made.

**ARTICLE 17. *Deductions for Uncorrected Work.*** If the Architect and Owner deem it inexpedient to correct work injured or done not in accordance with the Contract, an equitable deduction from the contract price shall be made therefor.

**ARTICLE 18. *Delays and Extension of Time.*** If the Contractor be delayed at any time in the progress of the work by any act or neglect of the Owner or the Architect, or of any employee of either, or by any separate Contractor employed by the Owner, or by changes ordered in the work, or by strikes, lockouts, fire, unusual delay in transportation, unavoidable casualties or any causes beyond the Contractor's control, or by delay authorized by the Architect pending arbitration, or by any cause which the Architect shall decide to justify the delay, then the time of completion shall be extended for such reasonable time as the Architect may decide.

No such extension shall be made for delay occurring more than seven days before claim therefor is made in writing to the Architect. In the case of a continuing cause of delay, only one claim is necessary.

If no schedule or agreement stating the dates upon which drawings shall be furnished is made, then no claim for delay shall be allowed on account of

failure to furnish drawings until two weeks after demand for such drawings and not then unless such claim be reasonable.

This article does not exclude the recovery of damages for delay by either party under other provisions in the contract documents.

**ARTICLE 19. *Correction of Work before Final Payment.*** The Contractor shall promptly remove from the premises all materials condemned by the Architect as failing to conform to the Contract, whether incorporated in the work or not, and the Contractor shall promptly replace and re-execute his own work in accordance with the Contract and without expense to the Owner and shall bear the expense of making good all work of other contractors destroyed or damaged by such removal or replacement.

If the Contractor does not remove such condemned work and materials within a reasonable time, fixed by written notice, the Owner may remove them and may store the material at the expense of the Contractor. If the Contractor does not pay the expenses of such removal within ten days' time thereafter, the Owner may, upon ten days' written notice, sell such materials at auction or at private sale and shall account for the net proceeds thereof, after deducting all the costs and expenses that should have been borne by the Contractor.

**ARTICLE 20. *Correction of Work after Final Payment.*** Neither the final certificate nor payment nor any provision in the Contract Documents shall relieve the Contractor of responsibility for faulty materials or workmanship and, unless otherwise specified, he shall remedy any defects due thereto and pay for any damage to other work resulting therefrom, which shall appear within a period of one year from the date of substantial completion. The Owner shall give notice of observed defects with reasonable promptness. All questions arising under this article shall be decided by the Architect subject to arbitration.

**ARTICLE 21. *The Owner's Right to Do Work.*** If the Contractor should neglect to prosecute the work properly or fail to perform any provision of this contract, the Owner, after three days' written notice to the Contractor may, without prejudice to any other remedy he may have, make good such deficiencies and may deduct the cost thereof from the payment then or thereafter due the Contractor, provided, however, that the Architect shall approve both such action and the amount charged to the Contractor.

**ARTICLE 22. *Owner's Right to Terminate Contract.*** If the Contractor should be adjudged a bankrupt, or if he should make a general assignment for the benefit of his creditors, or if a receiver should be appointed on account of his insolvency, or if he should persistently or repeatedly refuse or should fail, except in cases for which extension of time is provided, to supply enough properly skilled workmen or proper materials, or if he should fail to make prompt payment to subcontractors or for material or labor, or persistently disregard laws, ordinances or the instructions of the Architect, or otherwise be guilty of a substantial violation of any provision of the contract, then the Owner, upon the certificate of the Architect that sufficient cause exists to justify such action, may, without prejudice to any other right or remedy and after giving the Contractor seven days' written notice, terminate the employment of the Contractor and take possession of the premises and of all materials, tools and appliances thereon and finish the work by whatever method he may deem expedient. In such case the Contractor shall not be entitled to receive any further payment until the work is finished. If the unpaid balance of the contract price shall exceed the expense of finishing the work including compensation for additional managerial and admin-

istrative services, such excess shall be paid to the Contractor. If such expense shall exceed such unpaid balance, the Contractor shall pay the difference to the Owner. The expense incurred by the Owner as herein provided, and the damage incurred through the Contractor's default, shall be certified by the Architect.

ARTICLE 23. *Contractor's Right to Stop Work or Terminate Contract.* If the work should be stopped under an order of any court, or other public authority, for a period of three months, through no act or fault of the Contractor or of anyone employed by him, or if the Architect should fail to issue any certificate for payment within seven days after it is due, or if the Owner should fail to pay to the Contractor within seven days of its maturity and presentation, any sum certified by the Architect or awarded by arbitrators, then the Contractor may, upon seven days' written notice to the Owner and the Architect, stop work or terminate this contract and recover from the Owner payment for all work executed and any loss sustained upon any plant or materials and reasonable profit and damages.

ARTICLE 24. *Applications for Payments.* The Contractor shall submit to the Architect an application for each payment, and, if required, receipts or other vouchers, showing his payments for materials and labor, including payments to subcontractors as required by Article 37.

If payments are made on valuation of work done, such application shall be submitted at least ten days before each payment falls due, and, if required, the Contractor shall, before the first application, submit to the Architect a schedule of values of the various parts of the work, including quantities, aggregating the total sum of the contract, divided so as to facilitate payments to subcontractors in accordance with Article 37(e), made out in such form as the Architect and the Contractor may agree upon, and, if required, supported by such evidence as to its correctness as the Architect may direct. This schedule, when approved by the Architect, shall be used as a basis for certificates of payment, unless it be found to be in error. In applying for payments, the Contractor shall submit a statement based upon this schedule, and, if required, itemized in such form and supported by such evidence as the Architect may direct, showing his right to the payment claimed.

If payments are made on account of materials delivered and suitably stored at the site but not incorporated in the work, they shall, if required by the Architect, be conditional upon submission by the Contractor of bills of sale or such other procedure as will establish the Owner's title to such material or otherwise adequately protect the Owner's interest.

ARTICLE 25. *Certificates of Payments.* If the Contractor has made application as above, the Architect shall, not later than the date when each payment falls due, issue to the Contractor a certificate for such amount as he decides to be properly due.

No certificate issued nor payment made to the Contractor, nor partial or entire use or occupancy of the work by the Owner, shall be an acceptance of any work or materials not in accordance with this contract. The making and acceptance of the final payment shall constitute a waiver of all claims by the Owner, other than those arising from unsettled liens, from faulty work appearing after final payment or from requirement of the specifications, and of all claims by the Contractor, except those previously made and still unsettled.

Should the Owner fail to pay the sum named in any certificate of the Architect or in any award by arbitration, upon demand when due, the



Contractor shall receive, in addition to the sum named in the certificate, interest thereon at the legal rate in force at the place of building.

ARTICLE 26. *Payments Withheld.* The Architect may withhold or, on account of subsequently discovered evidence, nullify the whole or a part of any certificate to such extent as may be necessary to protect the Owner from loss on account of:

- (a) Defective work not remedied.
- (b) Claims filed or reasonable evidence indicating probable filing of claims.
- (c) Failure of the Contractor to make payments properly to subcontractors or for material or labor.
- (d) A reasonable doubt that the contract can be completed for the balance then unpaid.
- (e) Damage to another Contractor.

When the above grounds are removed payment shall be made for amounts withheld because of them.

ARTICLE 27. *Contractor's Liability Insurance.* The Contractor shall maintain such insurance as will protect him from claims under workmen's compensation acts and from any other claims for damages for personal injury, including death, which may arise from operations under this Contract, whether such operations be by himself or by any subcontractor or anyone directly or indirectly employed by either of them. Certificates of such insurance shall be filed with the Owner, if he so require, and shall be subject to his approval for adequacy of protection.

ARTICLE 28. *Owner's Liability Insurance.* The Owner shall be responsible for and at his option may maintain such insurance as will protect him from his contingent liability for damages for personal injury, including death, which may arise from operations under this contract.

ARTICLE 29. *Fire Insurance.* The Owner shall effect and maintain fire insurance upon the entire structure on which the work of this contract is to be done to one hundred per cent of the insurable value thereof, including items of labor and materials connected therewith whether in or adjacent to the structure insured, materials in place or to be used as part of the permanent construction including surplus materials, shanties, protective fences, bridges, or temporary structures, miscellaneous materials and supplies incident to the work, and such scaffoldings, stagings, towers, forms, and equipment as are not owned or rented by the contractor, the cost of which is included in the cost of the work. EXCLUSIONS: This insurance does not cover any tools owned by mechanics, any tools, equipment, scaffoldings, stagings, towers, and forms owned or rented by the Contractor, the capital value of which is not included in the cost of the work, or any cook shanties, bunk houses or other structures erected for housing the workmen. The loss, if any, is to be made adjustable with and payable to the Owner as Trustee for whom it may concern, except in such cases as may require payment of all or a proportion of said insurance to be made to a mortgagee as his interests may appear.

The Contractor, on his written request, shall be named jointly with Owner in all policies, all of which shall be open to his inspection. If the Owner fails to show them on request, or if he fails to effect or maintain insurance as above, the Contractor may insure his own interest and charge the cost thereof to the Owner. If the Contractor is damaged by failure of the Owner

to maintain such insurance, he may recover as stipulated in the contract for recovery of damages.

If required in writing by any party in interest, the Owner as Trustee shall, upon the occurrence of loss, give bond for the proper performance of his duties. He shall deposit any money received from insurance in an account separate from all his other funds and he shall distribute it in accordance with such agreement as the parties in interest may reach, or under an award of arbitrators appointed, one by the Owner, another by joint action of the other parties in interest, all other procedure being as provided elsewhere in the contract for Arbitration. If after loss no special agreement is made, replacement of injured work shall be ordered and executed as provided for changes in the work.

The Trustee shall have power to adjust and settle any loss with the insurers unless one of the Contractors interested shall object in writing within three working days of the occurrence of loss, and thereupon arbitrators shall be chosen as above. The Trustees shall in that case make settlement with the insurers in accordance with the directions of such arbitrators, who shall also, if distribution by arbitration is required, direct such distribution.

ARTICLE 30. *Guaranty Bonds.* The Owner shall have the right, prior to the signing of the Contract, to require the Contractor to furnish bond covering the faithful performance of the Contract and the payment of all obligations arising thereunder, in such form as the Owner may prescribe and with such sureties as he may approve. If such bond is required by instructions given previous to the submission of bids, the premium shall be paid by the Contractor; if subsequent thereto, it shall be paid by the Owner.

ARTICLE 31. *Damages.* If either party to this Contract should suffer damage in any manner because of any wrongful act or neglect of the other party or of anyone employed by him, then he shall be reimbursed by the other party for such damage.

Claims under this clause shall be made in writing to the party liable within a reasonable time at the first observance of such damage and not later than the time of final payment, except as expressly stipulated otherwise in the case of faulty work or materials, and shall be adjusted by agreement or arbitration.

ARTICLE 32. *Liens.* Neither the final payment nor any part of the retained percentage shall become due until the Contractor, if required, shall deliver to the Owner a complete release of all liens arising out of this Contract, or receipts in full in lieu thereof and, if required in either case, an affidavit that so far as he has knowledge or information the releases and receipts include all the labor and material for which a lien could be filed; but the Contractor may, if any subcontractor refuses to furnish a release or receipt in full, furnish a bond satisfactory to the Owner, to indemnify him against any lien. If any lien remain unsatisfied after all payments are made, the Contractor shall refund to the Owner all moneys that the latter may be compelled to pay in discharging such a lien, including all costs and a reasonable attorney's fee.

ARTICLE 33. *Assignment.* Neither party to the Contract shall assign the Contract or sublet it as a whole without the written consent of the other, nor shall the Contractor assign any moneys due or to become due to him hereunder, without the previous written consent of the Owner.

ARTICLE 34. *Mutual Responsibility of Contractors.* Should the Contractor cause damage to any separate contractor on the work the Contractor agrees,

upon due notice, to settle with such contractor by agreement or arbitration, if he will so settle. If such separate contractor sues the Owner on account of any damage alleged to have been so sustained, the Owner shall notify the Contractor, who shall defend such proceedings at the Owner's expense and, if any judgment against the Owner arise therefrom, the Contractor shall pay or satisfy it and pay all costs incurred by the Owner.

**ARTICLE 35. *Separate Contracts.*** The Owner reserves the right to let other contracts in connection with this work. The Contractor shall afford other contractors reasonable opportunity for the introduction and storage of their materials and the execution of their work, and shall properly connect and coordinate his work with theirs.

If any part of the Contractor's work depends for proper execution or results upon the work of any other contractor, the Contractor shall inspect and promptly report to the Architect any defects in such work that render it unsuitable for such proper execution and results. His failure so to inspect and report shall constitute an acceptance of the other contractor's work as fit and proper for the reception of his work, except as to defects which may develop in the other contractor's work after the execution of his work.

To insure the proper execution of his subsequent work the Contractor shall measure work already in place and shall at once report to the Architect any discrepancy between the executed work and the drawings.

**ARTICLE 36. *Subcontracts.*** The Contractor shall, as soon as practicable after the execution of the contract, notify the Architect in writing of the names of subcontractors proposed for the principal parts of the work and for such others as the Architect may direct and shall not employ any that the Architect may within a reasonable time object to as incompetent or unfit.

If the Contractor has submitted before execution of the contract a list of subcontractors and the change of any name on such list is required in writing by the Owner after such execution, the contract price shall be increased or diminished by the difference in cost occasioned by such change.

The Architect shall, on request, furnish to any subcontractor, wherever practicable, evidence of the amounts certified on his account.

The Contractor agrees that he is as fully responsible to the Owner for the acts and omissions of his Subcontractors and of persons either directly or indirectly employed by them, as he is for the acts and omissions of persons directly employed by him.

Nothing contained in the Contract Documents shall create any contractual relation between any subcontractor and the Owner.

**ARTICLE 37. *Relations of Contractor and Subcontractor.*** The Contractor agrees to bind every Subcontractor and every Subcontractor agrees to be bound by the terms of the Agreement, the General Conditions, the Drawings and Specifications as far as applicable to his work, including the following provisions of this article, unless specifically noted to the contrary in a subcontract approved in writing as adequate by the Owner or Architect.

This does not apply to minor subcontracts.

The Subcontractor agrees—

(a) To be bound to the Contractor by the terms of the Agreement, General Conditions, Drawings and Specifications, and to assume toward him all the obligations and responsibilities that he, by those documents, assumes toward the Owner.

(b) To submit to the Contractor applications for payment in such reasonable time as to enable the Contractor to apply for payment under Article 24 of the General Conditions.

(c) To make all claims for extras, for extensions of time and for damages for delays or otherwise, to the Contractor in the manner provided in the General Conditions for like claims by the Contractor upon the Owner, except that the time for making claims for extra cost is one week.

The Contractor agrees—

(d) To be bound to the Subcontractor by all the obligations that the Owner assumes to the Contractor under the Agreement, General Conditions, Drawings and Specifications, and by all the provisions thereof affording remedies and redress to the Contractor from the Owner.

(e) To pay the Subcontractor, upon the payment of certificates, if issued under the schedule of values described in Article 24 of the General Conditions, the amount allowed to the Contractor on account of the Subcontractor's work to the extent of the Subcontractor's interest therein.

(f) To pay the Subcontractor, upon the payment of certificates, if issued otherwise than as in (e), so that at all times his total payments shall be as large in proportion to the value of the work done by him as the total amount certified to the Contractor is to the value of the work done by him.

(g) To pay the Subcontractor to such extent as may be provided by the Contract Documents or the subcontract, if either of these provides for earlier or larger payments than the above.

(h) To pay the Subcontractor on demand for his work or materials as far as executed and fixed in place, less the retained percentage, at the time the certificate should issue, even though the Architect fails to issue it for any cause not the fault of the Subcontractor.

(j) To pay the Subcontractor a just share of any fire insurance money received by him, the Contractor, under Article 29 of the General Conditions.

(k) To make no demand for liquidated damages or penalty for delay in any sum in excess of such amount as may be specifically named in the subcontract.

(l) That no claim for services rendered or materials furnished by the Contractor to the Subcontractor shall be valid unless written notice thereof is given by the Contractor to the Subcontractor during the first ten days of the calendar month following that in which the claim originated.

(m) To give the Subcontractor an opportunity to be present and to submit evidence in any arbitration involving his rights.

(n) To name as arbitrator under arbitration proceedings as provided in the General Conditions the person nominated by the Subcontractor, if the sole cause of dispute is the work, materials, rights or responsibilities of the Subcontractor; or, if of the Subcontractor and any other subcontractor jointly, to name as such arbitrator the person upon whom they agree.

The Contractor and the Subcontractor agree that—

(o) In the matter of arbitration, their rights and obligations and all procedure shall be analogous to those set forth in this contract.

Nothing in this article shall create any obligation on the part of the Owner to pay to or to see to the payment of any sums to any Subcontractor.

ARTICLE 38. *Architect's Status.* The Architect shall have general supervision and direction of the work. He is the agent of the Owner only to the

extent provided in the Contract Documents and when in special instances he is authorized by the Owner so to act, and in such instances he shall, upon request, show the Contractor written authority. He has authority to stop the work whenever such stoppage may be necessary to insure the proper execution of the Contract.

As the Architect is, in the first instance, the interpreter of the conditions of the Contract and the judge of its performance, he shall side neither with the Owner nor with the Contractor, but shall use his powers under the contract to enforce its faithful performance by both.

In case of the termination of the employment of the Architect, the Owner shall appoint a capable and reputable Architect, against whom the Contractor makes no reasonable objection, whose status under the contract shall be that of the former Architect; any dispute in connection with such appointment to be subject to arbitration.

**ARTICLE 39. *Architect's Decisions.*** The Architect shall, within a reasonable time, make decisions on all claims of the Owner or Contractor and on all other matters relating to the execution and progress of the work or the interpretation of the Contract Documents.

The Architect's decisions, in matters relating to artistic effect, shall be final, if within the terms of the Contract Documents.

Except as above or as otherwise expressly provided in the Contract Documents, all the Architect's decisions are subject to arbitration.

If, however, the Architect fails to render a decision within ten days after the parties have presented their evidence, either party may then demand arbitration. If the Architect renders a decision after arbitration proceedings have been initiated, such decision may be entered as evidence but shall not disturb or interrupt such proceedings except where such decision is acceptable to the parties concerned.

**ARTICLE 40. *Arbitration.*** All disputes, claims or questions subject to arbitration under this contract shall be submitted to arbitration in accordance with the provisions, then obtaining, of the Standard Form of Arbitration Procedure of the American Institute of Architects, and this agreement shall be specifically enforceable under the prevailing arbitration law, and judgment upon the award rendered may be entered in the highest court of the forum, state or federal, having jurisdiction. It is mutually agreed that the decision of the arbitrators shall be a condition precedent to any right of legal action that either party may have against the other.

The Contractor shall not cause a delay of the work during any arbitration proceeding, except by agreement with the Owner.

Notice of the demand for arbitration of a dispute shall be filed in writing with the Architect and the other party to the contract. If the arbitration is an appeal from the Architect's decision, the demand therefor shall be made within ten days of its receipt; in any other case the demand for arbitration shall be made within a reasonable time after the dispute has arisen; in no case, however, shall the demand be made later than the time of final payment, except as otherwise expressly stipulated in the contract.

The arbitrators, if they deem that the case requires it, are authorized to award to the party whose contention is sustained, such sums as they or a majority of them shall deem proper to compensate it for the time and expense incident to the proceeding and, if the arbitration was demanded without reasonable cause, they may also award damages for delay. The arbitrators shall fix their own compensation, unless otherwise provided by

agreement, and shall assess the costs and charges of the proceeding upon either or both parties.

**ARTICLE 41. *Cash Allowances.*** The Contractor shall include in the contract sum all allowances named in the Contract Documents and shall cause the work so covered to be done by such contractors and for such sums as the Architect may direct, the Contract Sum being adjusted in conformity therewith. The Contractor declares that the Contract Sum includes such sums for expenses and profit on account of cash allowances as he deems proper. No demand for expenses or profit other than those included in the Contract Sum shall be allowed. The Contractor shall not be required to employ for any such work persons against whom he has a reasonable objection.

**ARTICLE 42. *Use of Premises.*** The Contractor shall confine his apparatus, the storage of materials and the operations of his workmen to limits indicated by law, ordinances, permits or directions of the Architect and shall not unreasonably encumber the premises with his materials.

The Contractor shall not load or permit any part of the structure to be loaded with a weight that will endanger its safety.

The Contractor shall enforce the Architect's instructions regarding signs, advertisements, fires and smoking.

**ARTICLE 43. *Cutting, Patching and Digging.*** The Contractor shall do all cutting, fitting or patching of his work that may be required to make its several parts come together properly and fit it to receive or be received by work of other contractors shown upon, or reasonably implied by, the Drawings and Specifications for the completed structure, and he shall make good after them as the Architect may direct.

Any cost caused by defective or ill-timed work shall be borne by the party responsible therefor.

The Contractor shall not endanger any work by cutting, digging or otherwise, and shall not cut or alter the work of any other contractor save with the consent of the Architect.

**ARTICLE 44. *Cleaning Up.*** The Contractor shall at all times keep the premises free from accumulations of waste material or rubbish caused by his employees or work, and at the completion of the work he shall remove all his rubbish from and about the building and all his tools, scaffolding and surplus materials and shall leave his work "broom clean" or its equivalent, unless more exactly specified. In case of dispute the Owner may remove the rubbish and charge the cost to the several contractors as the Architect shall determine to be just.

**Short Contract Form.** The foregoing contract forms are more elaborate than is necessary for small construction projects. For work of this classification a condensed form may be sufficient. The U.S. Standard "Invitation, Bid, and Acceptance" (Short Form Contract) and the A.I.A. "Short Form for Small Construction Contracts" are typical examples of this type of contract. It is noted that these forms contain the instructions to bidders, the contract, and general conditions combined in one document.

### EXAMPLES OF SHORT FORM CONTRACTS

U.S. Standard Form 33 (Revised)  
Approved by the Secretary  
of the Treasury  
January 17, 1939

Invitation No. ....

Contract No. \_\_\_\_\_

## INVITATION, BID, AND ACCEPTANCE

(SHORT FORM CONTRACT)

(Department or establishment)

(Office or station)

.....  
(Address)

-----  
(Date)

## INVITATION

Sealed bids, in ..... subject to the conditions on the  
reverse hereof, will be received at this office until ..... o'clock  
.....M., ....., and then publicly opened, for  
furnishing the following supplies, and/or services, for delivery at .....

(Name)

(Title)

Item No.	Articles or Services	Quantity	Unit	Unit Price	Amount	
					Dollars	Cents

**Bid**

(Date) .....

In compliance with the above invitation for bids, and subject to all the conditions thereof, the undersigned offers, and agrees, if this bid be accepted within ..... calendar days from the date of the opening, to furnish any or all of the items upon which prices are quoted, at the price set opposite each item, delivered at the point(s) as specified and, unless otherwise specified within ..... calendar days after receipt of order.

Discounts will be allowed for payment as follows: ..... percent 10 calendar days; ..... percent 20 calendar days; ..... percent 30 calendar days.

Bidder ..... Address .....

By ..... Title .....  
(Signature of person authorized to sign this bid)

**Acceptance by the Government**

(Date) .....

Accepted as to items numbered .....

Name ..... Title .....

**Conditions**

1. The Government reserves the right to reject any or all bids, to waive any informality in bids and, unless otherwise specified by the Government or by the bidder, to accept any item in the bid. In case of error in the extension of prices in the bid, the unit prices will govern.

2. Time, in connection with discount offered, will be computed from date of the delivery of the supplies to carrier when final inspection and acceptance are at point of origin, or from date of delivery at destination or port of embarkation when final inspection and acceptance are at those points, or from date correct bill or voucher properly certified by the contractor is received if the latter date is later than the date of delivery.

3. In case of default of the contractor, the Government may procure the articles or services from other sources and hold the contractor responsible for any excess cost occasioned thereby: *Provided*, That if public necessity requires the use of materials or supplies not conforming to the specifications they may be accepted and payment therefor shall be made at a proper reduction in price.

4. If the contractor refuses or fails to make deliveries of the materials or supplies within the time specified, or any extension thereof, the Government may by written notice terminate the right of the contractor to proceed with



deliveries or such part or parts thereof as to which there has been delay. In such event, the Government may purchase similar materials or supplies in the open market or secure the manufacture and delivery of the materials and supplies by contract or otherwise, and the contractor and his sureties (if any) shall be liable to the Government for any excess cost occasioned the Government thereby: *Provided*, That the contractor shall not be charged with any excess cost occasioned the Government by the purchase of materials or supplies in the open market or under other contracts when the delay of the contractor in making deliveries is due to unforeseeable causes beyond the control and without the fault or negligence of the contractor, including, but not restricted to, acts of God or of the public enemy, acts of the Government, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, unusually severe weather, and delays of a subcontractor due to such causes unless the contracting officer shall determine that the materials or supplies to be furnished under the subcontract are procurable in the open market, if the contractor shall notify the contracting officer in writing of the cause of any such delay, within 10 days from the beginning thereof, or within such further period as the contracting officer shall, with the approval of the head of the department or his duly authorized representative, prior to the date of final settlement of the contract, grant for the giving of such notice. The contracting officer shall then ascertain the facts and extent of delay, and his findings of fact thereon shall be final and conclusive on the parties hereto, subject only to appeal within 30 days by the contractor to the head of the department concerned or his duly authorized representative, whose decision on such appeal as to the facts of delay shall be final and conclusive, on the parties hereto. As used herein "head of the department" means the head or any assistant head of the executive department or independent establishment involved, and "his duly authorized representative" means any person authorized to act for him other than the contracting officer; and the term "contracting officer" shall include his duly appointed successor or his authorized representative.

5. No Member of or Delegate to Congress, or Resident Commissioner, shall be admitted to any share or part of this contract or to any benefit that may arise therefrom unless it be made with a corporation for its general benefit.

6. Prices bid herein include any Federal tax heretofore imposed by the Congress which is applicable to the material on this bid. If any sales tax, processing tax, adjustment charge, or other taxes or charges are imposed or changed by the Congress after the date set for the opening of this bid, and made applicable directly upon the production, manufacture, or sale of the supplies covered by this bid, and are paid by the contractor on the articles or supplies herein contracted for, then the prices named in this bid will be increased or decreased accordingly, and any amount due the contractor as a result of such change will be charged to the Government and entered on vouchers (or invoices) as separate items.

7. Unless otherwise specified by the bidder, it is understood and agreed that only such unmanufactured articles, materials, and supplies as have been mined or produced in the United States, and only such manufactured articles, materials, and supplies as have been manufactured in the United States substantially all from articles, materials, or supplies mined, produced, or manufactured, as the case may be, in the United States shall be delivered pursuant to a contract awarded as a result of this bid.

### Instructions to Bidders

1. Samples of items, when required, must be furnished, free of expense, prior to the opening of bids, and, if not destroyed, will, upon request, be returned at the bidder's expense.
2. Prices should be stated in units of quantity specified, with packing included.
3. Time of proposed delivery must be stated in definite terms. If time varies for different items the bidder shall so state.
4. Envelopes containing bids must be sealed and marked on the upper left-hand corner with the name and address of the bidder and the date and hour of opening, and addressed as instructed.
5. For further instructions read U.S. Standard Form 22 (Instructions to Bidders).

### Instructions to Contracting Officers

1. If shipment is made by Government bill of lading, observe consolidated classification requirements so as to secure the lowest rate applicable.
2. Although this form meets the requirements of a formal contract (R. S. 3744), if the execution of a formal contract with bond is contemplated U.S. Standard Forms 31 and 32 should be used.
3. If there is not sufficient space on the schedule to list all of the items, insert at the bottom of the schedule "continued on ..... sheets of U.S. Standard Form 36," and use that form also.
4. If it is definitely known that final acceptance cannot be accomplished within 10 or 20 days from date of delivery due to necessity for tests or analyses which cannot be accomplished within that time, delete, before issuance, the discount provision relating to 10 calendar days or to both 10 and 20 calendar days. The provision relating to discounts may also be deleted when funds do not become available so that payment may be made within such time limits.
5. If the contract is likely to involve patent liability, the article on patents as contained in U.S. Standard Form 32 should be used.
6. If the contract provides for liquidated damages, the above Condition No. 4 should be deleted and there should be substituted therefor the article entitled "Delays—Liquidated Damages," quoted in Paragraph 5 of the directions on page 6, U.S. Standard Form 32, modified as follows: Delete "in Article 1," line 2, and if no bond is required, delete "and his sureties," lines 6 and 10; add the last sentence (definitions) of the above Condition No. 4.

**THE A.I.A.\* SHORT FORM  
FOR  
SMALL CONSTRUCTION CONTRACTS**

**AGREEMENT AND GENERAL CONDITIONS BETWEEN  
CONTRACTOR AND OWNER**

Issued by the American Institute of Architects for use only when the proposed work is simple in character, small in cost, and when a stipulated sum forms the basis of payment. For other contracts the Institute issues the standard form of agreement between contractor and owner for construction of buildings and the standard general conditions in connection therewith for use when a stipulated sum forms the basis for payment.

First edition, copyright, 1936, by the American Institute of Architects,  
the Octagon, Washington, D. C.

THIS AGREEMENT made the ..... day of .....  
in the year Nineteen Hundred and ....., by and between .....  
..... hereinafter called the Contractor, and .....  
..... hereinafter called the Owner.  
WITNESSETH, that the Contractor and the Owner for the considerations  
hereinafter named agree as follows:

ARTICLE 1. *Scope of the Work.* The Contractor shall furnish all of the  
material and perform all of the work for .....  
(Caption indicating the portion or portions of work covered)

as shown on the drawings and described in the specifications entitled

prepared by ..... Architect  
all in accordance with the terms of the contract documents.

ARTICLE 2. *Time of Completion.* The work shall be substantially completed

ARTICLE 3. *Contract Sum.* The Owner shall pay the Contractor for the  
performance of the contract subject to the additions and deductions pro-  
vided therein in current funds, the sum of ..... dollars.  
(\$.....)

ARTICLE 4. *Progress Payments.* The Owner shall make payments on  
account of the contract, upon requisition by the contractor, as follows:

\* Reproduced by permission of the American Institute of Architects.

**ARTICLE 5. *Acceptance and Final Payment.*** Final payment shall be due ..... days after completion of the work, provided the contract be then fully performed, subject to the provisions of Article 16 of the General Conditions.

**ARTICLE 6. *Contract Documents.*** Contract documents are as noted in Article 1 of the General Conditions. The following is an enumeration of the drawings and specifications:

### General Conditions

**ARTICLE 1. *Contract Documents.*** The contract includes the **Agreement** and its **General Conditions**, the **Drawings**, and the **Specifications**. Two or more copies of each, as required, shall be signed by both parties and one signed copy of each retained by each party.

The intent of these documents is to include all labor, materials, appliances and services of every kind necessary for the proper execution of the work, and the terms and conditions of payment therefor.

The documents are to be considered as one, and whatever is called for by any one of the documents shall be as binding as if called for by all.

**ARTICLE 2. *Samples.*** The Contractor shall furnish for approval all samples as directed. The work shall be in accordance with approved samples.

**ARTICLE 3. *Materials, Appliances, Employes.*** Except as otherwise noted, the Contractor shall provide and pay for all materials, labor, tools, water, power and other items necessary to complete the work.

Unless otherwise specified, all materials shall be new, and both workmanship and materials shall be of good quality.

All workmen and sub-contractors shall be skilled in their trades.

**ARTICLE 4. *Royalties and Patents.*** The Contractor shall pay all royalties and license fees. He shall defend all suits or claims for infringement of any patent rights and shall save the Owner harmless from loss on account thereof.

**ARTICLE 5. *Surveys, Permits, and Regulations.*** The Owner shall furnish an adequate survey of the property. The Contractor shall obtain and pay for all permits necessary for the prosecution of the work. He shall comply with all laws and regulations bearing on the conduct of the work and shall notify the Owner if the drawings and specifications are at variance therewith.

**ARTICLE 6. *Protection of Work, Property, and Persons.*** The Contractor shall adequately protect the work, adjacent property and the public and shall be responsible for any damage or injury due to his act or neglect.

**ARTICLE 7. *Inspection of Work.*** The Contractor shall permit and facilitate inspection of the work by the Owner and his agents and public authorities at all times.

**ARTICLE 8. *Changes in the Work.*** The Owner may order changes in the work, the Contract Sum being adjusted accordingly. All such orders and adjustments shall be in writing. Claims by the Contractor for extra cost must be made in writing before executing the work involved.

**ARTICLE 9. *Correction of Work.*** The Contractor shall re-execute any work that fails to conform to the requirements of the contract and that appears during the progress of the work, and shall remedy any defects due to faulty materials or workmanship which appear within a period of one

year from the date of completion of the contract. The provisions of this article apply to work done by sub-contractors as well as to work done by direct employees of the Contractor.

**ARTICLE 10. *Owner's Right to Terminate the Contract.*** Should the Contractor neglect to prosecute the work properly, or fail to perform any provision of the contract, the Owner, after seven days' written notice to the Contractor, may, without prejudice to any other remedy he may have, make good the deficiencies and may deduct the cost thereof from the payment then or thereafter due the Contractor or, at his option, may terminate the contract and take possession of all materials, tools, and appliances and finish the work by such means as he sees fit, and if the unpaid balance of the contract price exceeds the expense of finishing the work, such excess shall be paid to the Contractor, but if such expense exceeds such unpaid balance, the Contractor shall pay the difference to the Owner.

**ARTICLE 11. *Contractor's Right to Terminate Contract.*** Should the work be stopped by any public authority for a period of thirty days or more, through no fault of the Contractor, or should the work be stopped through act or neglect of the Owner for a period of seven days, or should the Owner fail to pay the Contractor any payment within seven days after it is due, then the Contractor upon seven days' written notice to the Owner, may stop work or terminate the contract and recover from the Owner payment for all work executed and any loss sustained and reasonable profit and damages.

**ARTICLE 12. *Payments.*** Payments shall be made as provided in the Agreement. The making and acceptance of the final payment shall constitute a waiver of all claims by the Owner, other than those arising from unsettled liens or from faulty work appearing thereafter, as provided for in Article 9, and of all claims by the Contractor except any previously made and still unsettled. Payments otherwise due may be withheld on account of defective work not remedied, liens filed, damage by the Contractor to others not adjusted, or failure to make payments properly to sub-contractors or for material or labor.

**ARTICLE 13. *Contractor's Liability Insurance.*** The Contractor shall maintain such insurance as will protect him from claims under Workmen's Compensation Acts and from any other claims for damages for personal injury, including death, which may arise from operations under this contract. Certificates of such insurance shall be filed with the Owner, if he so require, and shall be subject to his approval for adequacy of protection.

**ARTICLE 14. *Owner's Liability Insurance.*** The Owner shall be responsible for and at his option may maintain such insurance as will protect him from his contingent liability for damages for personal injury, including death, which may arise from operations under this contract.

**ARTICLE 15. *Fire Insurance.*** The Owner shall effect and maintain fire insurance upon the entire structure on which the work of this contract is to be done and upon all materials, in or adjacent thereto and intended for use thereon, to at least eighty per cent of the insurable value thereof. The loss, if any, is to be made adjustable with and payable to the Owner as Trustee for whom it may concern, except in such cases as may require payment of all or a proportion of said insurance to be made to a mortgagee as his interests may appear.

The insurance shall cover the following items and labor connected therewith whether in or adjacent to the structure insured:—materials in place or to be used as part of the permanent construction including surplus

materials, shanties or temporary structures, scaffoldings, and stagings, protective fences, bridges, forms, and miscellaneous materials and supplies necessary to the work.

The insurance shall not cover any tools owned by mechanics or any tools or equipment owned or rented by the Contractor, and the Owner shall not be responsible for any loss on such property.

ARTICLE 16. *Liens.* The final payment shall not be due until the Contractor has delivered to the Owner a complete release of all liens arising out of this contract, or receipts in full covering all labor and materials for which a lien could be filed, or a bond satisfactory to the Owner indemnifying him against any lien.

ARTICLE 17. *Separate Contracts.* The Owner has the right to let other contracts in connection with the work and the Contractor shall properly cooperate with any such other contractors.

ARTICLE 18. *The Architect's Status.* The Architect shall have general supervision of the work. He has authority to stop the work if necessary to insure its proper execution. He shall certify to the Owner when payments under the contract are due and the amounts to be paid. He shall make decisions on all claims of the Owner or Contractor. All his decisions are subject to arbitration.

ARTICLE 19. *Arbitration.* Any disagreement arising out of this contract or for the breach thereof, shall be submitted to arbitration and this agreement shall be specifically enforceable under the prevailing arbitration law, and judgment upon the award rendered may be entered in the highest court of the forum, state or federal, having jurisdiction. It is mutually agreed that the decision of the arbitrators shall be a condition precedent to any right of legal action that either party may have against the other.

The parties may agree upon one arbitrator; otherwise there shall be three, one named in writing by each party of this contract within five days after notice of arbitration is served by either party upon the other, and a third arbitrator selected by these two arbitrators within five days thereafter. No one shall serve as an arbitrator who is in any way financially interested in this contract or in the affairs of either party thereto.

At the written request of either party, at any time prior to the complete appointment of arbitrators, as provided above, or in the event of any default or lapse in the proceeding, the arbitration shall be held under the Standard Form of Arbitration Procedure of the American Institute of Architects or of the Rules of the American Arbitration Association.

ARTICLE 20. *Cleaning Up.* The Contractor shall keep the premises free from accumulation of waste material and rubbish and at the completion of the work he shall remove from the premises all rubbish, implements and surplus materials and leave the building broom clean.

IN WITNESS WHEREOF the parties hereto executed this Agreement, the day and year first above written.

[Signatures]

### Questions

1. Explain the contractual significance of the advertisement, instructions to bidders, and the bid after a formal contract is executed.

2. In planning the general form of a contract, what are the arguments for and against dividing the contract into two parts, the agreement and the general conditions of the contract?

3. Why should the word "bidder" not appear in the contract?

4. What are the factors to be considered in fixing the time of completion?

5. What provisions should be made for changes in the work under a lump-sum contract? Name four methods for arriving at the change in the contract amount to cover the cost of changes in the work, and give the advantages and disadvantages of each.

6. Progress payments to the contractor usually cover 90 per cent of the work completed during the payment period, 10 per cent being retained. What is the owner's justification for this procedure?

7. Progress payments by the owner to the contractor are based on certificates prepared by the engineer and addressed to the owner. Write an engineer's progress payment certificate for the work completed during one month on highway construction under a unit-price contract. The quantities completed during this period and the contract unit prices were as follows.

Earth excavation	1,600 cu. yd. @ \$ 0.75
Rock excavation	430 cu. yd. @ 6.00
Borrow-pit excavation	1,200 cu. yd. @ 1.00
Concrete pavement	6,000 sq. yd. @ 3.50
Curb and gutter	2,000 lin. ft. @ 1.90
12-inch drain pipe	400 lin. ft. @ 5.40
Spillway assemblies	4 each @ 40.00
Reinforcing steel	60,000 lb. @ 0.10

8. Make a comparative analysis of the standard contract forms of the U.S. Government, the American Railway Engineering Association, and the American Institute of Architects.

9. The engineer for a public commission in charge of construction of an elevated railway ruled that a change in the concrete finish required on the columns and some changes in the steel construction required at stations were to be classified and paid for at contract unit prices. The contractor, on the other hand, claimed that these were changes for which he was entitled to extra compensation. The commission insisted that the determination of the engineer was final and binding upon the contractor. The contractor filed suit against the commission and was awarded extra compensation by the court. On what basis could the court make this decision?

10. The contractor on a contract with the U.S. Government for the construction of a dam had set up a conveyor system in gravel pits about 6,000 feet downstream from the dam. The contract made the contractor responsible for all risk of damage to his plant, equipment, and operations at

the gravel pit by reason of flood. After the plant had been in operation for several months, a flood occurred. Before the flood, however, the government, by separate contract or by force account, had been clearing the basin above the dam, and much debris including large logs was left in the basin. These were carried away by the flood, lodged against the towers of the conveyor system, and caused the collapse of the towers and a general wrecking of the plant. Was the contractor or the Government liable for the damage? (See *Engineering News-Record*, January 29, 1942, page 63.)



# 6

## COST-PLUS-A-FIXED-FEE CONTRACTS

The fundamental concept of the cost-plus-a-fixed-fee type of negotiated contract is mutual faith and confidence between the owner and the contractor, and the selection of the contractor should be made with this end in view. Though an element of competition may be introduced in connection with the amount of the fixed fee, it is advisable to select the contractor on the basis of other considerations, the amount of the fee and the terms of the contract being determined after the contractor is selected.

**Selection of Contractor.** The selection of the contractor should be based primarily on the following considerations.

- a.* Previous experience in the particular type of work.
- b.* Reputation for fairness and excellence in performance.
- c.* Quality and experience of personnel.
- d.* Available working capital.
- e.* Available plant and equipment.
- f.* Normal volume of work per year.
- g.* Uncompleted work in progress.
- h.* Available work capacity (difference between normal volume and uncompleted work in progress).

Information along these lines should be collected and classified systematically, preferably by some form of questionnaire. This procedure is, in effect, similar to prequalification, and prequalification questionnaires are suitable for the purpose. An analysis of these data will usually indicate one or more contractors suitable for the work. Final selection should be made after conferences during which the details of the contractor's qualifications are further developed.

**Determination of the Fee.** After the contractor has been selected, separate negotiations are conducted relative to the amount of the fee. This should be based on the estimated construction cost, the character and magnitude of the work, the esti-

mated time of completion, and the amount of the work to be accomplished by subcontract. It should be clearly understood that, once the amount of the fee has been agreed upon, it remains unchanged regardless of the accuracy of the estimate of cost since changes in the fee are approved only in the case of material changes in the scope of the work.

Fees for engineering construction work normally vary from about 2 to 10 per cent of the estimated construction cost, with a decrease in the percentage as the magnitude increases. Because of the more specialized skill required, fees will also be higher for heavy subaqueous work, for example, than for light construction on dry land. In order to determine a fee that will be fair and reasonable to both parties to the contract, it is necessary to have available only rough preliminary plans which are sufficient to indicate the nature and magnitude of the work and to form the basis of a preliminary estimate of cost. The estimate is understood to be approximate, but it should be acceptable to both parties as a consideration in the determination of the fee. In view of these conditions considerable variation between the original estimate and the actual cost of the work is to be expected at the completion of the work.

Usually it is expected that about 20 to 25 per cent of the work will be accomplished by specialty subcontractors. If more than this amount is contemplated the prime contractor should receive a lower fee than would be allowed normally. Subcontracts are normally drawn on a lump-sum basis. If cost-plus-a-fixed-fee subcontracts are desired to meet special conditions, provisions should be made in the prime contract for their approval and the determination of subcontractors' fees.

**Terms of the Contract.** Because of the elasticity of this type of contract many of the terms, which are necessary in other forms, may be omitted. Specifications may also be condensed or developed as the work progresses. This works no hardship on the contractor since all direct costs are reimbursable. It is not unusual for the specifications to be issued in the form of memorandum instructions as the plans for the work are developed. In general, the essential elements of the contract are:

- a. Definition of the scope of the work, its estimated cost, and the amount of the contractor's fee.

- b.* Control of the work; responsibilities of the owner, engineer, and contractor.
- c.* Definition of reimbursable direct costs and overhead.
- d.* Provisions for plant rental, maintenance of equipment, and the overhaul of equipment at the end of the job.
- e.* Method of compensation.
- f.* Changes.
- g.* Special requirements of the particular project.

**Scope of the Work.** Since the contractor is to be paid a fixed sum for the accomplishment of a definite amount of work, it is necessary that the scope of the project be defined with great care. It is expected that minor changes will be made in the owner's plans as the work develops, but any material change implies a corresponding change in the contractor's fee and requires special authorization. At the time of the award of the contract, it will be impossible to describe the details of the work, and, generally, detail plans will not be available. In most cases the proper selection of the title of the project, a description of its general features, and a preliminary estimate of its cost will define the owner's intention relative to the scope of the work. Dimensions are desirable when available.

The following may be considered as an illustration of the significance of scope in relation to the contractor's fee. Under a contract for a building, it may be understood that the structure will include concrete floors 4 inches thick. If the thickness is changed later to 6 inches, this is considered to be a detail of design, and no change in scope is involved although the cost may be changed appreciably. It is obvious that the original intent included floors. However, if the building is changed from four stories to five, it is evident that the owner's general intention has changed during the progress of the work, and the contractor is entitled to a change in fee.

**Control of the Work.** The contract should provide for a representative of each party in whom is vested responsibility for the carrying out of the requirements of the work and who has authority to act on all matters pertaining to the contract. Provision should also be made for the allocation of responsibility for the preparation of plans, specifications, shop drawings, approval

of accounting methods, inspection of materials and workmanship, termination of contract, settlement of disputes, approval of purchases and subcontracts, licenses, permits, patent-rights, progress schedules, etc. In general, the owner will be represented by the engineer and the contractor by his superintendent.

**Reimbursable Direct Costs.** Under this form of contract the contractor is reimbursed in the amount of the actual net cost (out-of-pocket expenditures) of the work paid by him, plus the fixed fee. Excluded from the cost should be interest on money, cost of financing the project, commissions or brokerage fees, salaries and expenses of principals of the contractor's firm, and, generally, all expenses of the contractor's central office. It is assumed that these items of cost are covered by the contractor's fee. The contractor's central office expenses should be excluded because of the difficulty in allocating these charges to the various contracts under which work may be in progress concurrently. Any consideration of the excluded items should be made in connection with the determination of the amount of the fixed fee. Overhead expenses and other indirect costs should be reimbursed only when they are incurred on the job and can be definitely allocated to the work under the contract. Exceptions to this requirement may be made when it can be definitely shown that the work under the contract is occupying the contractor's entire organization and all his expenses are definitely allocable to the work in question. In this case, it may be more economical to handle some features of the work in the central office than on the job. A similar condition would exist when the project is not sufficiently large to warrant the setting up of a field office to handle purchasing, payments, and other administrative functions on the job.

**Plant Rental and Equipment Overhaul.** The contract should require the contractor to furnish all plant and equipment required for the work on a rental basis as an element of the cost of the project. Two methods are commonly used to determine the amount of the rentals. The procedure recommended by the Associated General Contractors of America is based on a flat rental rate for each type of equipment. This is simple to apply, but it has the disadvantage that no distinction is made in the payment for similar pieces of equipment of different ages and production

capacity. The Bureau of Yards and Docks determines rental rates on the basis of actual annual cost of ownership to the contractor. Payment under this method includes insurance premiums, depreciation, property taxes, interest on investment, and general administration and operating expenses. Neither method should allow a profit to the contractor, all profit being covered by the fixed fee. The contract should provide for operating repairs during the course of the work and a general overhaul at the end of the work to replace the equipment in its original condition less normal wear and tear. In view of the uncertainties that are likely to arise at the end of the work relative to the original condition, it is advisable that a survey and appraisal of the equipment be made both at the beginning and at the end of the work.

When it becomes necessary to use a piece of equipment not owned by the contractor, the owner may either have to purchase and furnish it himself or the contractor must rent it from a third party. Such a rental will be on a different basis than that of contractor-owned equipment in that the rental rate will include a profit for the owner of the equipment. Third party rentals require close control since they work to the advantage of the contractor and the disadvantage of the owner. Where possible during the preliminary negotiations a definite understanding should be reached relative to specific items of equipment to be purchased by the owner or rented from third parties.

The contract should be explicit where maximum total rental and recapture provisions are desired. On large contracts provision is sometimes made for rental payments to stop when the total rental paid equals some specified percentage of the purchase price of the equipment. Recapture clauses permit the owner to purchase the equipment from the contractor at any time during the life of the contract, previously paid rental being applied to the purchase price.

**Method of Compensation.** At predetermined intervals of from seven days to thirty days the contractor should submit payment vouchers accompanied by certified payrolls, paid invoices, bills, and other expenses, all previously approved by the engineer. Payment to the contractor should be made as soon as possible after receipt of the requisition. The payment should also include a proportional payment on account of the fixed fee.

**Changes.** Changes may be made at any time in the drawings and specifications within the general scope of the work without altering the conditions of the contract. However, if such changes cause a material change in the amount or character of the work, a corresponding adjustment should be made in the contractor's fee. All changes should be made formally by written order. If the change is minor in character and related directly to the contract work, the engineer may handle the matter by the issuance of a written change order, accepted by the owner and by the contractor, in which a proportional adjustment is made in the fee. When the change involves a large alteration in plans or when new projects of considerable magnitude are introduced into the contract, it is recommended that the work be covered by a supplemental agreement prepared for formal acceptance by both parties.

**Some Precautions in the Use of Cost-Plus-Fixed-Fee Contracts.** As in other types of construction contracts, uncertainties and disputes will arise unless the administrative control of the work is properly planned and executed. Experience in the use of the cost-plus-fixed-fee form indicates that controversies are most likely to occur in connection with the following.

*a.* Changes in scope. All matters related to changes in the scope of the work and the corresponding changes in the contractor's fee should be settled definitely at the time the change is ordered and before the work is completed.

*b.* Equipment rental and overhaul. The methods for determining the amounts of equipment rental rates and the basis for repair and overhaul allowances should be definitely established at the beginning of the work in order to avoid controversies when the contract is being closed out.

*c.* Subcontracts and third-party rentals. If it is intended that any subcontracts are to be approved on a fixed-fee basis, the conditions relative to the duplication of fees paid to the prime contractor and the subcontractor for the same services should be agreed upon at the beginning of the work. This also applies to equipment rented from third parties on rates different from those established for the equipment owned by the prime contractor.

*d.* Cost accounting system. Uncertainties in cost finding and delays due to controversies over reimbursable costs may be ex-

pected unless the details of the accounting methods are worked out and agreed upon in advance.

*e.* On large projects the work may be broken down into several separate contracts, some of which may be on a cost-plus basis, whereas others are let by competitive bidding. On such work no contractor should be allowed to have contracts of both types concurrently because of the difficulty in separating the non-reimbursable costs under the competitive-bid contract from the reimbursable costs under the cost-plus contract.

*f.* Closing out of the contract. The contractor, either voluntarily or involuntarily, tends to slow down production and drag out the work toward the completion of the contract. This tendency may be more pronounced if the contractor has no other work in view in order to maintain his organization on a reimbursable basis as long as possible. Therefore, increasing overhead and production costs are to be expected near the end of the work. If this tendency should develop, its objectionable results may be avoided by terminating the cost-plus-fixed-fee contract and arranging for the completion of the unfinished portion of the work on a lump-sum or unit-price basis under a new contract with the same contractor.

**U.S. Government Cost-Plus-Fixed-Fee Contracts.** It should be noted that all government contracts are subject to review by the General Accounting Office. This agency has the authority to reverse previous findings by contracting officers. In the case of cost-plus-fixed-fee contracts, reimbursable items of cost previously approved and paid under the contract may be held unjustifiable by the General Accounting Office. Such action results ultimately in a claim against the contractor for the return of the disallowed funds. If good faith on the part of the contractor and the Government Contracting Officer is assumed, this situation results in a unique hazard to the contractor which must be anticipated when he enters into the contract. A similar hazard exists with regard to renegotiation proceedings which may be instituted at the completion of the work under war conditions, with the view of ascertaining the extent to which the contractor's profit under the contract may be considered excessive. The contractor is obliged to return to the government the full amount of the excess profit.

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## EXAMPLE OF COST-PLUS-A-FIXED-FEE CONTRACT

Y&D Form 187  
April, 1943

Contract No.

## CONTRACT

(COST PLUS A FIXED FEE)  
(CONSTRUCTION)

THIS NEGOTIATED CONTRACT, entered into as of the \_\_\_\_\_ day of \_\_\_\_\_, 19\_\_\_\_, by THE UNITED STATES OF AMERICA, hereinafter called the Government, represented by the Chief of the Bureau of Yards and Docks, Navy Department, hereinafter called the Contracting Officer, acting under the direction of the Secretary of the Navy, and

hereinafter called the Contractor,

WITNESSETH: Whereas the Secretary of the Navy is authorized, by the First War Powers Act, 1941, to enter into contracts without regard to the provisions of law relating to the making, performance, amendment or modification of contracts in order to facilitate the prosecution of the war; and,

Whereas, in the judgment of the Secretary of the Navy the prosecution of the war will be facilitated by the accomplishment of the work hereinafter specified.

the parties hereto, with the intent and purpose to accomplish certain project hereinafter mentioned within the shortest practicable time by cooperative effort, pursuant to authorized and approved negotiations, do mutually agree as follows:

ARTICLE 1. *Work to Be Done and Fixed Fee.* (a) The Contractor shall construct or otherwise accomplish the completion of the following public works project at the location indicated, said project being designated by general titles and the estimated cost of same being stated to indicate generally the degree of magnitude and not a limit of cost, viz.:

(b) The above mentioned project designated by general titles may be further indicated by lists of individual projects to be prepared and approved by the Contracting Officer to define with more particularity the scope of the work contemplated by the contract and such lists may be furnished to the Contractor and be considered to be a part of the contract.

(c) The Government reserves the right to omit or suspend the construction or accomplishment of any part or portion of any project or to include



the construction or accomplishment of any additional project or projects as it finds necessary or desirable in the interests of the National Defense.

(d) The amount of the fixed fee is

ARTICLE 2. *Government Officers.* (a) The Government will designate an officer of the Civil Engineer Corps, U.S. Navy, as "Officer in Charge of Construction," hereinafter referred to as "Officer in Charge," who, under the direction of the Contracting Officer, shall have complete charge, on behalf of the Government, of the work under this contract in the field.

(b) The terms "Contracting Officer" and "Officer in Charge" as used in this contract shall in each instance include the duly appointed successor of such designated Officer and likewise any person or persons authorized to act for him or his successor.

ARTICLE 3. *Contractor's Representative.* (a) The Contractor shall designate a Superintendent, who, on behalf of the Contractor, shall have complete charge of all work under this contract.

(b) The Contractor shall also designate such qualified or experienced engineers as may be required, each of whom, under the direction of the Superintendent shall have charge in the field, on behalf of the Contractor, of such projects or sections or divisions of projects as may be designated by the Contractor.

ARTICLE 4. *Government Plans and Specifications.* The projects indicated in Article 1, as and when accomplished, shall conform to plans and specifications which may be furnished by the Government to the Contractor from time to time during the progress of the work covered by the contract.

ARTICLE 5. *Contractor's Plans and Specifications.* (a) The Contractor shall furnish all plans and specifications to supplement those furnished by the Government, which may be determined by the Contracting Officer to be necessary for the accomplishment of the projects and all plans and specifications so furnished by the Contractor shall be subject to approval by the Contracting Officer.

(b) The Contractor shall keep at the field office a copy of all necessary drawings and specifications and shall at all times give the Officer in Charge access thereto. In any case of an apparent discrepancy in the figures, drawings, or specifications, the matter shall be submitted to the Officer in Charge for decision.

ARTICLE 6. *Time of Completion.* The Contractor shall proceed immediately with the organization of office and field forces to be engaged upon the work under this contract and shall direct his efforts toward early purchases and transportation of materials and the initiation of actual construction work on the site and shall concentrate upon rapid progress and the completion of the entire work at the earliest possible date.

ARTICLE 7. *Plant and Equipment.* (a) The Contractor shall provide all plant and equipment required for the accomplishment of the work under this contract except such articles or pieces of equipment as shall be purchased by the Government under the terms of Article 9 hereof or be otherwise furnished by the Government, but no article or piece of equipment costing in excess of \$200 shall be purchased and none shall be rented at a rental rate in excess of \$100 per month except after prior approval in writing by the Contracting Officer.

(b) The rental compensation for items of plant and equipment owned, or controlled for use hereunder as if owned, by the Contractor shall be calculated on the basis of cost to the Contractor with no allowance for profit. There will be included unless otherwise financed (1) insurance

premiums, if any allowed, (2) depreciation, (3) property taxes, (4) interest on investment, (5) general administration and plant expenses. Rental compensation under this paragraph shall be calculated, for the equipment listed therein, in accordance with such Plant and Equipment Cost and Rental Schedule, as may be required and approved by the Contracting Officer. In the case of any other such items of plant and equipment not listed in said schedule but subsequently furnished, rental compensation under this paragraph shall be calculated in the same manner and upon the same basis.

(c) Fifteen percent (15%) will be retained from all rental compensation payable under this article to provide for proper reimbursement on account of possible savings under the arrangement set forth in said schedule.

(d) All equipment shall be delivered to the work in first class working condition. During the progress of the work repairs shall be made as required by the exigencies of the work. At the end of the work, the equipment shall be placed in as good condition as when delivered to the work, minus ordinary wear and tear for which the depreciation allowance noted above is considered to be adequate compensation. The cost of these repairs shall constitute items of cost under the contract.

(e) In calculating payments for plant rentals no deduction from or additions to the normal monthly rates shall be made on account of idle time or shift work, respectively.

(f) In calculating the actual rental costs the total allowance for "depreciation" shall not exceed 50% of the "insurable value" of the equipment when it was delivered to the work.

(g) The Contracting Officer may in his discretion and on behalf of the Government, take possession at any place he may elect of any item of plant or equipment for the purpose of transporting it to the site where it is to be used or held for further disposition and may subsequently return any such item to the possession of the Contractor for use on the work.

(h) Final disposition of all items of the Government plant and equipment shall be made as directed by the Contracting Officer.

(i) The title of each item of plant and equipment purchased for the Government passes directly from the vendor to the Government as set forth in Article 9 hereof.

(j) The Contractor agrees to use such items of plant and equipment and such shop, storage, transportation, communication, and other facilities owned by the Government as may be available to him and as directed by the Officer in Charge.

ARTICLE 8. *Services and Labor.* (a) All services and labor, including personal services of every character, except such as may be furnished by the Government, required outside the central office organization of the Contractor for the accomplishment of the work under this contract shall be furnished by the Contractor. The salaries or compensation paid for services and labor shall be subject to the approval of the Contracting Officer and as hereinafter provided.

(b) The Contractor or his subcontractor shall pay all mechanics and laborers employed directly upon the site of the work, unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such pay roll deductions as are permitted by applicable regulations prescribed by the Secretary of Labor), the full amounts accrued at time of payment, computed at wage rates not less than those stated in the schedule appended hereto and made a part hereof

(Exhibit "A"), regardless of any contractual relationship which may be alleged to exist between the Contractor or subcontractor and such laborers and mechanics; and the scale of wages to be paid shall be posted by the Contractor in a prominent and easily accessible place at the site of the work. The Contracting Officer shall have the right to withhold from the Contractor so much of accrued payments as may be considered necessary by the Contracting Officer to pay to laborers and mechanics employed by the Contractor or any subcontractor on the work the difference between the rates of wages required by the contract to be paid laborers and mechanics on the work and the rates of wages received by such laborers and mechanics and not refunded to the Contractor, subcontractors or their agents.

(c) In the event it is found by the Contracting Officer that any laborer or mechanic employed by the Contractor or any subcontractor directly on the site of the work covered by the contract has been or is being paid a rate of wages less than the rate of wages required by the contract to be paid as aforesaid, the Government may, by written notice to the Contractor, terminate his right to proceed with the work or such part of the work as to which there has been a failure to pay said required wages and prosecute the work to completion by contract or otherwise, and the Contractor shall be liable to the Government for any excess costs occasioned the Government thereby.

(d) No person shall be assigned to service by the Contractor as Superintendent of Construction, Chief Engineer, Chief Purchasing Agent, Chief Accountant, or similar position in the field organizations, or as principal assistant to any such person, until his employment has been approved by the Contracting Officer. There shall be submitted to the Contracting Officer such information as he may request as to the experience, qualifications and former compensation of such persons. Contracts for such services, so far as they shall constitute items of cost to the Government, shall include provisions as to salary or compensation and as to traveling, lodging, subsistence, leaves of absence, and special (if any) allowances, and shall be subject to approval by the Contracting Officer.

(e) This contract is subject to the provisions of Section 303 of the Second Supplemental National Defense Appropriation Act, 1941 (Public No. 781, 76th Congress), approved September 9, 1940.

(f) The Contractor shall not employ any persons undergoing sentence of imprisonment at hard labor.

(g) The Contracting Officer may require the Contractor to dismiss from the work any employee that the Contracting Officer deems incompetent, careless, insubordinate, trouble-making, or otherwise objectionable.

(h) The Contracting Officer may, in his discretion and on behalf of the Government, provide transportation facilities for personnel employed by the Contractor to and from the site of the work under the contract, and the Contractor shall, upon request of the Contracting Officer, furnish such transportation and subsistence while in a travel status as the Contracting Officer may specify for officers and employees of the Government engaged upon, or regularly or intermittently on duty in the Navy Department or elsewhere in connection with the work under this contract.

(i) No persons other than those engaged upon the work under the contract shall be lodged or quartered upon any naval reservation within which work under the contract is being carried on or allowed to visit the site of any such work except when so authorized by a pass issued by the Officer-in-Charge or superior authority.

(j) The Contractor, in performing the work required by this contract, shall not discriminate against any worker because of race, creed, color or national origin. The Contractor further agrees that each subcontract made under this contract will contain a similar provision with respect to non-discrimination.

ARTICLE 9. *Materials—Purchases.* (a) All materials, articles, supplies and equipment (other than Contractor-owned), required for the accomplishment of the work under this contract shall be provided as hereinafter stated, including materials, articles, and supplies required for temporary use and such as may be consumed in use.

(b) Except where provision is otherwise made by the Contracting Officer, all such materials, articles, supplies, and equipment shall be procured by the Contractor. The Contractor shall act as the purchasing agent of the Government in effecting such procurement, and the Government shall be directly liable to the vendors for the purchase price. The exercise of this agency and the imposition of such liability upon the Government are subject to the obtaining of approval in the instances and in the manner required by subparagraph (d) of this article. The Contractor shall negotiate and administer all such purchases and shall advance all payments therefor, unless the Contracting Officer shall otherwise direct.

(c) Title to all such materials, articles, supplies and equipment, the cost of which is reimbursable to the Contractor hereunder, shall pass directly from the vendor to the Government without vesting in the Contractor, and such title (except as to property to which the Government has obtained title at an earlier date) shall vest in the Government at the time payment is made therefor by the Government or by the Contractor or upon delivery thereof to the Government or the Contractor, whichever of said events shall first occur. This provision for passage of title shall not relieve the Contractor of any of its duties or obligations under this contract or constitute any waiver of the Government's right to absolute fulfillment of all of the terms hereof.

(d) No purchase in excess of \$500 shall be made hereunder without the prior written approval of the Contracting Officer, except that the Contracting Officer may, in his discretion, authorize the Contractor to make purchases as such agent in amounts not in excess of \$2500 for any one purchase without obtaining such prior approval of the Contracting Officer.

(e) No subcontract shall be entered into by the Contractor without prior approval in writing of the Contracting Officer.

(f) Each cost-plus-a-fixed-fee subcontract shall, unless otherwise directed by the Contracting Officer, provide that the subcontractor shall act as the purchasing agent of the Government to the extent and with the same authority as that specified in subparagraph (b) of this article in regard to such action by the Contractor, and shall likewise provide that title to purchases for which the subcontractor is entitled to reimbursement shall pass to the Government in the same manner as that specified in subparagraph (c) of this article in regard to purchases for the cost of which the Contractor is entitled to reimbursement.

(g) The Contracting Officer may take charge of any such materials, articles, supplies, or equipment, procured under this contract, for the purpose of transporting them to the site where they are to be used or held for further disposition. Final disposition of surplus articles shall be made as directed by the Contracting Officer.

ARTICLE 10. *Grade of Materials and Workmanship.* Unless otherwise authorized by the Contracting Officer, all workmanship, equipment, materials, and articles incorporated in the work covered by this contract or provided for temporary use are to be of the most suitable grade of their respective kinds for the purpose. Where equipment, materials, or articles are referred to in specifications as "equal to" any particular standard, the Contracting Officer shall decide the question of equality. When required by specifications, or when called for by the Contracting Officer, the Contractor shall furnish the Contracting Officer for approval information concerning the materials or articles which they contemplate incorporating in the work. Samples of materials shall be submitted for approval when so directed by the Officer-in-Charge.

ARTICLE 11. *Inspections.* (a) All materials and workmanship, except as may be otherwise provided herein or otherwise authorized by the Contracting Officer, shall be subject to inspection, examination, and test by Government inspectors, or inspectors employed by the Contractor with the approval of the Contracting Officer, at any and all times during manufacture and/or construction at any and all places where such manufacture and/or construction are carried on. The Government shall have the right to reject defective material and workmanship or require its correction. Rejected workmanship shall be satisfactorily corrected and rejected material shall be satisfactorily replaced with proper material, and the Contractor shall promptly segregate and remove the rejected items from the premises.

(b) The Contractor shall furnish promptly all reasonable facilities, labor, and materials necessary for the safe and convenient inspection and tests that may be required by the inspectors. All inspection and tests by the Government shall be performed in such manner as not to unnecessarily delay the work. Special, full size, and performance tests shall be as specified.

(c) Should it be considered necessary or advisable by the Government at any time before final acceptance of the entire work to make an examination of work already completed by removing or tearing out same, the Contractor shall on request of the Contracting Officer promptly furnish all necessary facilities, labor, and material for the purpose.

(d) Inspection of material and finished articles to be incorporated in the work at the site shall be made at the place of production, manufacture, or shipment, whenever the quantity justifies it, unless otherwise stated in specifications; and such inspection and acceptance, unless otherwise stated in specifications shall be final, except as regards latent defect, departures from specific requirements of the contract and the specifications and drawings furnished as provided for by Articles 4 and 5 hereof, or loss in transit, fraud, or such gross mistakes as amount to fraud. Subject to the requirements contained in the preceding sentence, the inspection of material and workmanship for final acceptance as a whole or in part shall be made at the site.

(e) The actual net cost to the Contractor of labor, facilities, and material necessarily incident to the inspections provided in this Article including the correction or replacement of defective material and workmanship and of reconstruction, shall be allowed the Contractor as a reimbursable cost, provided, however, that in the event of disclosure of defects resulting from gross negligence or fraud of the Contractor, the cost of the examination and of satisfactory correction, replacement or reconstruction in respect of such defects shall be borne by the Contractor and he is expressly made responsible therefor without right of reimbursement hereunder.

**ARTICLE 12. *Changes.*** The Contracting Officer may at any time, by a written order, make changes in approved drawings and/or specifications within the general scope thereof, or suspend, omit, or add projects or parts thereof. If such changes or the addition of any project or omission or suspension of any part or portion of the original project cause a material increase or decrease in the amount or character of the work to be done under this contract, an equitable adjustment of the amount of the fixed fee to be paid to the Contractor shall be made by the Contracting Officer and upon written notice thereof to the Contractor the contract shall be deemed to be modified in writing accordingly. Any claim by the Contractor for modification of such adjustment must be asserted within ten days from the date he receives such written notice of such adjustment; *provided, however,* That the Contracting Officer, if he determines that the facts justify such action, may receive and consider, and with the approval of the Secretary of the Navy or his duly authorized representative, adjust any such claim asserted at any time prior to the date of final settlement of the contract. If the parties fail to agree upon the adjustment to be made the dispute shall be determined as provided in Article 14 hereof. But nothing provided in this article shall excuse the Contractor from proceeding with the prosecution of the work so changed.

**ARTICLE 13. *Termination of Contract.*** (a) Should the Contractor at any time refuse, neglect or fail to prosecute the work with promptness and diligence, or should conditions arise which in the opinion of the Contracting Officer make it advisable or necessary for the interests of the Government to cease work under this contract, the Government may terminate this contract by a notice in writing from the Contracting Officer to the Contractor. Such termination shall be effective in the manner and upon the date specified in said notice and shall be without prejudice to any claims which the Government may have against the Contractor. Upon receipt of such notice, the Contractor shall promptly comply with all instructions of the Contracting Officer in the premises, whether contained in such notice or subsequently given, including without limitation his instructions concerning the following matters: the discontinuance of the work and acquisitions therefor; the furnishing of information concerning, and the action to be taken respecting, all outstanding orders and subcontracts; the disposition of property in the possession of the Contractor in which the Government has an interest; and the action to be taken to preserve and protect work already in progress, and material, plant and equipment on such work or in transit thereto.

(b) If the ground, or one of the grounds, for terminating the contract is, in the opinion of the Contracting Officer, a default of the Contractor, the notice of termination shall so state, and the Contracting Officer may at his option and in addition to all other rights the Government may have, forthwith enter upon the premises and take that possession thereof and of all materials, tools, equipment, appliances, privileges, rights and options (including without limitation all rights to possession of real property) and facilities owned or controlled by the Contractor which the Contracting Officer may determine is essential to the completion of the work, and may complete, or employ any person or persons to complete, the work.

(c) Upon the termination of the contract as hereinbefore provided, full and complete settlement of all claims of the Contractor arising out of this contract shall be made as follows:

1. The Government shall assume and become liable for all obligations, commitments, and claims which the Contractor theretofor in good faith may have undertaken or incurred in connection with said work and which would in due course have been reimbursable under the provisions of this contract. The Contractor shall execute and deliver all such papers and take all such steps as the Contracting Officer may require for the purpose of fully vesting in the Government the rights and benefits of the Contractor under such obligations and commitments.

2. If any of the Contractor's equipment is retained by the Government under the provisions of this Article, full compensation therefor shall be made either by purchase, or rental (on the basis specified in Article 7, or otherwise agreed upon), at the election of the Contracting Officer.

3. The Government shall pay to the Contractor (a) the total cost of the work incurred to date of termination payable under the terms of this contract less payments to date of termination; (b) plus a fee as compensation for services of the Contractor, said fee to be determined by an equitable adjustment, as provided in Article 12 hereof, of the fee described in Article 1 hereof, less all payments made on account of such fee to date of termination.

4. The Government shall likewise in those instances where payment is not otherwise herein provided, reimburse to the Contractor the actual net cost, as approved by the Contracting Officer, of complying with the instructions of the Contracting Officer under this Article.

5. The obligation of the Government to make any of the payments required by this Article shall be subject to reasonable withholding for any unsettled claims which the Government may have against the Contractor, and for any unsettled claims against the Contractor for labor or materials.

**ARTICLE 14. *Disputes.*** Except as may be otherwise specifically provided in this contract, all disputes concerning questions of fact arising under this contract shall be decided by the Contracting Officer, subject to written appeal by the Contractor within 30 days to the Secretary of the Navy or his duly authorized representative, whose decision shall be final and conclusive upon the parties hereto. In the meantime, the Contractor shall diligently proceed with the work as directed.

**ARTICLE 15. *Licenses and Permits.*** The Contractor shall determine what permits or licenses are required in connection with the accomplishment of the work under this contract and, with the approval of the Contracting Officer, shall take the necessary action to secure the same as required: *Provided*, That all sites of the work covered by this contract and essential working spaces adjacent thereto which are owned by or under the control of the Government will be made available to the Contractor by the Government. Any such permits or licenses issued by any Federal Government Department or agency will, upon request made by the Contractor, be procured by the Contracting Officer.

**ARTICLE 16. *Other Contracts.*** The Government may award other contracts for work at the site of any work under this contract or may perform work with Government labor and the Contractor shall fully co-operate with any other contractor and/or Government labor forces and carefully fit his own work to that provided under other contracts or performed by Government labor as may be directed by the Contracting Officer.

**ARTICLE 17. *Non-Rebate of Wages.*** The Contractor shall comply with the regulations of the Secretary of Labor, entitled "Regulations Applicable to Contractors and Subcontractors on Public Building and Public Work and on Building and Work Financed in Whole or in Part by Loans or

Grants from the United States" (7 F.R. 687, 925, 2591), and any amendments or modifications thereof, pursuant to the Copeland Act of June 13, 1934, 48 Stat. 498 (U.S. Code, title 40, sections 276b and 276c), and shall insert in subcontracts appropriate provisions which will require compliance therewith by all subcontractors subject thereto, except as the Secretary of Labor may specifically provide for reasonable limitations, variations, tolerances, and exemptions from the requirements of said regulations and any amendments or modifications thereof.

ARTICLE 18. *Contingent Fees.* The Contractor warrants that he has not employed any person to solicit or secure this contract upon any agreement for a commission, percentage, brokerage, or contingent fee. Breach of this warranty shall give the Government the right to terminate the contract, or in its discretion, to deduct from the contract fixed-fee the amount of such commission, percentage, brokerage, or contingent fee. This warranty shall not apply to commissions payable by the Contractor upon contracts or sales secured or made through bona fide established commercial or selling agencies maintained by the Contractor for the purpose of securing business.

ARTICLE 19. *Non-Participation of Officials.* No member of or Delegate to Congress, or Resident Commissioner nor any other person belonging to or employed in the service of the United States, shall be admitted to any share or part of this contract or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this contract if made with a corporation for its general benefit.

ARTICLE 20. *Final or Conditional Acceptance of Work.* The Government reserves the right to take over and accept any completed part of the project or work unconditionally at any time its interests require, as determined by the Contracting Officer, and to take over any uncompleted part of the project or work conditionally for Government use under such working arrangement as may be agreed upon by the parties to the contract, and in the event of inability to reach such an arrangement, then upon such terms as the Contracting Officer may prescribe. Such prescribed terms shall be subject to appeal by the Contractor under the provisions of Article 14, but shall be complied with pending the decision on such appeal.

ARTICLE 21. *Contractor's Organization and Methods.* (a) Upon the execution of this contract the Contractor shall submit to the Contracting Officer a chart showing the Executive and Administrative personnel to be regularly assigned for full or part time service in connection with the work under the contract, together with a written statement of the duties of each person and the administrative procedure to be followed by the Contractor for the control and direction of the work; and the data so furnished shall be supplemented as additional pertinent data become available. There shall also be submitted to the Contracting Officer by the Contractor charts of the various field organizations showing all personnel, other than artisans, mechanics, helpers and laborers, to be assigned for full or part time service outside of the central office organization, together with a written statement of the duties and rates of pay of each person and the procedure proposed to be followed by the Contractor for the accomplishment of all field work, including temporary requirements; and the data so furnished shall be supplemented as additional pertinent data become available.

(b) The Contractor agrees that no representative provided for in Article 3 hereof nor any other employee occupying a key position in the field organization will be withdrawn or separated from his assignment during



the progress of the work except for cogent reasons and after full consultation with the Contracting Officer.

**ARTICLE 22. *Police and Guard Forces.*** The Contractor shall provide and maintain at the site an efficient and reliable police and guard force, if and as directed by the Contracting Officer, for the protection of personnel and property. No person shall be assigned to such force except after approval by the Officer in Charge. In any case where an officer authorized to exercise command has been assigned to duty at the locality indicated in Article 1 hereof, such officer shall have control of any employee of the Contractor detailed for guard or police duty and will arrange for the deputizing of such employee.

**ARTICLE 23. *Records and Accounts.*** (a) The Contractor shall keep accurate records and books of accounts, and shall record and report with all essential details the receipt and disbursement of all funds, the obligations and commitments outstanding, the cost and use of all items of labor, material, equipment, supplies, services, and charges of every kind procured or used under the provisions of this contract outside of the central office organization, and such expenses of the central office organization as may be specially authorized by the Contracting Officer, estimates of cost to complete all divisions and classifications of the work under contract, and such construction unit costs as may be required. The method of accounting employed by the Contractor shall be in accordance with the Bureau of Yards and Docks, "Manual of Accounting, Auditing, and Control for Negotiated Cost-plus-a-fixed-fee Contracts," subject to such modifications therein as may be authorized or directed by the Contracting Officer.

(b) The Contracting Officer shall at all reasonable times have access to all records and books of account pertaining to this contract. All information obtained from said records and books of account shall be treated as confidential.

(c) The Contractor shall preserve all documents, records and books of account pertaining to this contract; provided, however, that if the Contractor, at any time after the lapse of six (6) years following the date upon which the final payment under the contract becomes due, desires to dispose of said documents, records and books of account, he shall so notify the Contracting Officer, who shall either authorize their destruction or notify the Contractor to turn them over to the Government for disposition, and the Contractor shall promptly comply with such notice if given.

(d) Should the Contractor enter into any subcontract on a cost-plus-a-fixed-fee basis which is incidental to the performance of this contract, the foregoing provisions of this article shall be applicable to, and included in, such subcontract.

**ARTICLE 24. *Patented Articles or Inventions.*** (a) The Contractor shall hold and save the Government, its officers, agents, servants, and employees, harmless from patent liability of any nature or kind, including costs and expenses, for or on account of any patented or unpatented invention made or used in the performance of this contract, including the use or disposal thereof by or on behalf of the Government: *Provided*, That the foregoing shall not apply to inventions covered by applications for United States Letters Patent which, on the date of execution of this contract, are being maintained in secrecy under the provisions of Title 35, U.S. Code (1940 ed.), section 42, as amended; *Provided further*, That this Article is not, and shall not be construed to be, applicable to any infringement of United States Letters Patent which results from the Contractor's complying with specific

written instructions furnished by the Government, or where infringement is occasioned by the use of an apparatus patent due to the fabrication, installation, or operation of apparatus in accordance with plans and specifications furnished to the Contractor by the Government.

(b) The Contractor shall promptly notify the Government in writing of any and all claims of infringement relating to this contract that may be brought to the Contractor's attention and in case of litigation on account thereof, the Contractor shall assist the Government at the latter's expense, save for services of the Contractor's employees, in furnishing such evidence as to the use of the patents and other matters of fact as may be required by the Government in such litigation.

ARTICLE 25. *Compensation.* (a) The Government, in consideration of the strict performance by the Contractor of his covenants and agreements herein contained, shall pay to the Contractor the sum of the actual net cost, as hereinafter specified, paid by the Contractor in accordance with the provisions of this contract in the accomplishment of the work, plus the fixed-fee stated in Article 1(d).

(b) In the aforesaid net cost there shall not be included any cost of financing the contract, any interest on moneys, any commission, percentage, brokerage or contingent fee within the prohibition of Article 18, hereof, rent of the regular central offices of the Contractor, services or traveling expenses of any officer or employee included in the central office organization of the Contractor except as may be specifically authorized by the Contracting Officer, regular central office supplies and equipment or operating expense or any other expense incident to the maintenance and operation of said regular central office organization. In determining the actual net cost of articles and materials of every kind required for the purposes of this contract, there shall be deducted from the gross cost thereof all cash and trade discounts, rebates, allowances, credits, salvage values and commissions which have accrued to the benefit of the Contractor, or would have so accrued except for the fault or neglect of the Contractor. Such benefits lost through no fault of the Contractor shall not be deducted from gross cost. The Contractor shall, to the extent of his ability, take advantage of all such benefits and if unable to do so in any instance, shall promptly notify the Officer in Charge in writing to that effect and the reason therefor.

(c) It is the general intent and understanding by and between the parties to this Contract that the Contractor shall be reimbursed for all out-of-pocket advances and expenditures made by the Contractor for or on account of the contract which are specifically or impliedly authorized, sanctioned, or approved by the Contracting Officer. The term "actual net cost" shall include specifically, but not necessarily exclusively, the following:

1. The actual net cost paid by the Contractor for all items of plant and equipment purchased by the Contractor for the Government in accordance with Article 9 hereof, with the approval of the Contracting Officer and the amount of rental approved by the Contracting Officer for plant and equipment owned or procured by the Contractor under the provisions of Article 7 hereof, for use in connection with the work under this contract, including such insurance, transportation, and other collateral expense, incidental thereto, as the Contracting Officer may approve.

2. The actual net cost to the Contractor of all services, labor, transportation, and subsistence furnished under the provisions of Article 8 hereof,

including the cost of hiring, medical examination, transportation, hospitalization, subsistence, leave and holiday pay, and other usual expenses incident to the employment of labor, as may be authorized by the Contracting Officer.

3. The actual net cost paid by the Contractor for all materials procured in accordance with the provisions of Article 9 hereof, including purchasing, inspecting, storing, transporting, salvaging, and other usual expenses incident to the procurement and use of materials, as may be authorized by the Contracting Officer.

4. The actual net cost to the Contractor, if any there be, in addition to payments otherwise authorized, of inspections made under the provisions of Article 11 hereof, reimbursement being limited as therein provided.

5. The actual net cost to the Contractor, if any there be, in addition to payments otherwise authorized, of changes made under the provisions of Article 12 hereof.

6. The amount, other than that allocable to the fixed fee, found due to the Contractor upon settlement in the event this contract is terminated under the provisions of Article 13 hereof.

7. The actual net cost to the Contractor of any licenses or permits secured by him under the provisions of Article 15 hereof.

8. The actual net cost to the Contractor, if any there be, in addition to payments otherwise authorized, for any guard or police forces provided by him under the provisions of Article 22 hereof.

9. The actual net cost to the Contractor, if any there be, in addition to payments otherwise authorized, in connection with the keeping of records and books of accounts under the provisions of Article 23 hereof.

10. The actual net cost to the Contractor of any licenses or royalties furnished or paid by him with the approval of the Contracting Officer.

11. The actual net cost to the Contractor of the rental and maintenance of any space or structures or the erection of structures required for temporary use in connection with the accomplishment of this contract as may be authorized by the Contracting Officer and for which payment is not otherwise authorized.

12. The actual net cost to the Contractor of communication service necessary for the purposes of this contract, including telegrams, telephone service, radio messages, postage, couriers, and other means, as may be authorized by the Contracting Officer and for which payment is not otherwise authorized.

13. The net amount of any U.S. taxes and any state, territorial or local taxes, fees, or charges (except taxes or other exactions imposed upon or by reason of or measured by the Contractor's fee) which the Contractor may be required, on account of this contract, to pay on or for any plant, equipment, process, organization, materials, or personnel, or otherwise on account of the performance of the contract, under any applicable valid law or regulations issued by competent authority. The Contractor shall take such action in respect to protesting and/or suing to recover such taxes or any thereof as the Contracting Officer may direct.

14. The actual net cost to the Contractor of liabilities (including expenses incidental thereto) to third persons to the extent that reimbursement is provided in Article 32 hereof.

15. The actual net cost to the Contractor of insurance to the extent that reimbursement is provided in Article 32 hereof and of any bonds or special

insurance required in connection with this contract by direction or with the approval of the Contracting Officer.

16. Any amount found by the Contracting Officer to be due to the Contractor upon settlement after final acceptance of all work accomplished under this contract.

ARTICLE 26. *Payments to the Contractor.* (a) The Contractor may submit to the Officer in Charge at intervals of not less than seven calendar days payment requisitions accompanied by duly certified and approved paid pay rolls, paid invoices, paid bills or other substantiating documents, including the Contractor's bill on account of the prescribed fixed-fee, all equaling the amount of the requisition. Payment requisitions covering all items shall be submitted to the Officer in Charge. As soon as practicable after the receipt of such payment requisition there will be prepared a Public Voucher, in the amount of such requisition as is approved by the Officer in Charge, which voucher shall be signed by a duly authorized representative of the Contractor, and thereafter by the Contracting Officer, and thereupon transmitted to such Naval Disbursing Officer as may be designated by the Contracting Officer for issuance and delivery of a Government check drawn payable to the order of the Contractor. The Contracting Officer shall have the right to defer approval of payments at any time in an amount not to exceed ten percentum of all payments previously made on account of the Contractor's fees if in his judgment such action is necessary to properly protect the interests of the Government.

(b) Subject to the withholding provisions of the preceding paragraph, partial payments on account of the fixed-fee shall be in the same proportion to such fee as payments of reimbursable costs to the Contractor are to the estimated cost of the work (exclusive of the fixed-fee), as such cost is currently estimated by the Officer in Charge.

ARTICLE 27. *Release of Claims.* The Contractor shall as a condition precedent to the receipt of final payment hereunder, furnish the Government with a release, in such form and containing such terms and conditions as shall be acceptable to the Contracting Officer, of claims against the Government arising under or by virtue of this contract.

ARTICLE 28. *Reports of Espionage, Sabotage or Subversive Activities.* (a) The Contractor agrees that he will immediately submit a confidential report to the Contracting Officer with copies to such other Government agencies as the Contracting Officer may designate, whenever the Contractor has information indicating (1) that any of his employees may be engaged in subversive activity at any place or (2) that an active danger of espionage or sabotage exists at any plant, factory or site at which work under this contract is being performed or at which material acquired, fabricated or manufactured in connection with the performance of this contract is stored. The report shall contain a complete statement of such information. The Contractor agrees that he will instruct his personnel to submit any information coming to their attention with respect to the foregoing.

(b) The Contractor agrees that he will, whenever directed by the Contracting Officer, submit any and all information which the Contractor may have concerning any of his employees engaged in work at any plant, factory or site at which work under this contract is being performed.

(c) The Contractor agrees that he will refuse to employ or if already employing will forthwith discharge from employment, and will exclude from any plant, factory or site at which work under this contract is being performed, any person or persons whom the Secretary of the Navy or his

duly authorized representatives, in the interest of security against espionage, sabotage or subversive activity may designate.

(d) In each subcontract or purchase order which the Contractor may make or place under this contract the Contractor shall include stipulations which shall conform substantially to the language of the preceding paragraphs of this Article; *Provided*, That such stipulations need not be in any subcontract or purchase order for standard or commercial products procured under specifications which will not disclose the nature or character of the subject matter of this contract; *Provided*, further, that such stipulations need not be included in a subcontract or purchase order if the Contracting Officer or the Naval Inspector charged with the duty of inspecting of work or materials covered by this contract shall consent to the omission of such stipulations or to the inclusion of different stipulations therein.

ARTICLE 29. *Transfer of Contract and Assignment of Contractor's Claims.*

(a) Neither this contract, nor any interest herein except as otherwise provided in this article, shall be transferred by the Contractor to any other party or parties.

(b) Claims for moneys due or to become due to the Contractor from the Government arising out of this contract may be assigned to any bank, trust company or other financing institution including any Federal lending agency. Any such assignment shall cover all amounts payable under this contract and not already paid, shall not be subject to further assignment, and shall not be made to more than one party, except that any such assignment may be made to one party as agent or trustee for two or more parties participating in the financing of this contract. In the event of any such assignment, the assignee thereof shall file written notice of the assignment, together with a true copy of the instrument of assignment with (1) the General Accounting Office of the Government, (2) the Contracting Officer, (3) the surety or sureties upon the bond or bonds, if any, in connection with this contract, and (4) with the disbursing officer designated to make payments under this contract.

(c) Payments to an assignee of any claims arising under this contract shall not be subject to reduction or set-off for any indebtedness of the Contractor to the United States arising independently of this contract.

ARTICLE 30. *Labor Statistics.* The Contractor shall report monthly to the Department of Labor, and shall by agreement require his subcontractors to report in like manner within five (5) days after the close of each calendar month, on forms to be furnished by the Department of Labor, the number of persons on their respective pay rolls, the aggregate amount of such pay rolls, the man-hours worked, and the total expenditures for materials. The Contractor shall furnish to the Department of Labor the names and addresses of all subcontractors on the work at the earliest date practicable: *Provided, however*, that the requirements of this paragraph shall be applicable only to work performed hereunder at the site of the construction project.

ARTICLE 31. *Renegotiation.* Pursuant to Section 403 of the Sixth Supplemental National Defense Appropriation Act, 1942, as amended:

(a) Upon the written request of the Secretary of the Navy at such period or periods when in the judgment of the Secretary the profits accruing under this contract can be determined with reasonable certainty, the contract price shall be renegotiated to eliminate therefrom such amount as is found as a result of such renegotiation to represent excessive profits.

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(b) Any profits found as a result of such renegotiation to be excessive and not eliminated through reductions in the contract price hereunder or otherwise, shall, as the Secretary of the Navy may direct, (1) be retained by the Government from amounts otherwise due the Contractor, or (2) be repaid by the Contractor to the Government, if such excessive profits have been paid to the Contractor.

(c) The Contractor shall require the insertion of the following provisions in each subcontract for an amount in excess of \$100,000 directly entered into by the Contractor under this contract:

1. Upon the written request of the Secretary of the Navy at such period or periods when in the judgment of the Secretary the profits accruing under this contract can be determined with reasonable certainty, the contract price

shall be renegotiated by the Secretary of the Navy and .....  
(Subcontractor)

to eliminate therefrom such amount as is found as a result of such renegotiation to represent excessive profits.

2. Any profits found as a result of such renegotiation to be excessive and not eliminated through reductions in the contract price hereunder or otherwise, shall, as the Secretary of the Navy may direct, (i) be retained by

..... for the Government, or (ii) be repaid by  
(Contractor)

..... to the Government, if such excessive profits  
(Subcontractor)

have been paid to .....  
(Subcontractor)

3. .... is hereby relieved from any liability to  
(Contractor)

..... on account of any amount retained or repaid  
(Subcontractor)

pursuant to paragraph (2) above.

4. .... shall, upon the direction of the Secretary of  
(Subcontractor)

the Navy, require the insertion in any subcontract made hereunder, of contract provisions conforming substantially to the provisions of this Article.

5. Any renegotiation under this Article shall be conducted pursuant to the provisions of Section 403 of the Sixth Supplemental National Defense Appropriation Act, 1942, as amended.

(d) Any profits under any subcontract hereunder which are found as the result of renegotiation to be excessive and which the Contractor is directed by the Secretary of the Navy to withhold from payments otherwise due the subcontractor and actually unpaid at the time of receipt of such direction,

shall, as the Secretary of the Navy may direct, (1) be retained by the Government from amounts otherwise due the Contractor, or (2) be repaid by the Contractor to the Government.

(e) Any renegotiation under this Article shall be conducted pursuant to the provisions of Section 403 of the Sixth Supplemental National Defense Appropriation Act, 1942, as amended.

(f) For the purpose of this Article,

1. the term "Secretary of the Navy" shall be deemed to include any authorized representative of the Secretary of the Navy, and

2. the term "subcontract" means any purchase order or agreement to perform all or any part of the work or to make or furnish any article, required for the performance of another contract or subcontract, unless exempted from the provisions of Section 403, as amended, under subsection (i) thereof. The term "article," as used in this definition, includes any material, part, assembly, machinery, equipment, or other personal property.

*ARTICLE 32. Insurance—Property Loss—Liability to Third Persons.* (a) *Property Loss or Damage.* (1) The Contractor is requested not to carry, or incur the expense of any insurance against any form of loss of or damage to equipment or materials furnished by the Government hereunder, or any property to which the Government has taken and continues to hold title hereunder and no reimbursement will be allowed for such insurance premium expense.

(2) The Government assumes the risk of loss of or damage to such property, whether or not caused by the negligence of the Contractor, his agents, servants, or employees, including expenses incidental to such loss or damage. Notwithstanding the foregoing assumption of risk, the Contractor shall be responsible for any loss or damage for which he is expressly made responsible under any other provision of this contract, or which results from willful misconduct or lack of good faith on the part of any of the Contractor's directors, officers or any of his other representatives having supervision or direction individually or collectively of all or substantially all of the Contractor's operations under this contract.

(b) *Liability to Third Persons.* (1) The Contractor shall procure and thereafter maintain workmen's compensation, employer's liability, and bodily injury liability insurance, with respect to work done hereunder, and such other liability insurance with respect to such work as the Contracting Officer may from time to time require or approve. All such insurance shall be in such form, in such amounts, for such periods of time, and with such insurers, as the Contracting Officer may require or approve.

(2) The Contractor shall be reimbursed (i) for the cost or such insurance of the character described in paragraph (b) (1) of this Article as may be required or approved by the Contracting Officer, and (ii) for liabilities (including expenses incidental thereto) to third persons for loss of or damage to property, death or bodily injury, not compensated by insurance or otherwise, arising out of the performance of this contract, whether or not caused by the negligence of the Contractor, his agents, servants, or employees, except liabilities (I) for which the Contractor is otherwise responsible under the express terms of this contract, or (II) with respect to which the Contractor has failed to insure as required or approved by the

Contracting Officer, or (III) which result from willful misconduct or lack of good faith on the part of any of the Contractor's directors, officers or any of his other representatives having supervision or direction individually or collectively of all or substantially all of the Contractor's operations under this contract. Said reimbursable liabilities shall be reimbursed only if represented by final judgments or by settlements approved in writing by the Contracting Officer.

(3) The Contractor shall give the Contracting Officer immediate notice of any suit or action filed, or any claim made, against the Contractor arising out of the performance of this contract, the cost and expense of which is reimbursable to the Contractor under the provisions of this contract, and the risk of which is then uninsured or in which the amount claimed exceeds the amount of insurance coverage. The Contractor shall furnish immediately to the Contracting Officer copies of all pertinent papers received by the Contractor. If the amount of the liability claimed exceeds the amount of insurance coverage, the Contractor shall authorize representatives of the Government to collaborate with counsel for the insurance carrier, if any, in settling or defending such claim. If the liability is not insured, the Contractor shall, if required by the Contracting Officer, authorize representatives of the Government to settle or defend any such claim and to represent the Contractor in or take charge of any litigation in connection therewith.

ARTICLE 33. *Failure of Government to Insist on Compliance.* The failure of the Government, in any one or more instances, to insist upon strict performance of any of the terms of this contract or to exercise any option herein conferred, shall not be construed as a waiver or relinquishment for the future of any such terms or options.

ARTICLE 34. *Composition of Contractor.* If the term "Contractor" as used herein includes more than one legal entity, then each entity so included shall be jointly and severally liable for the undertakings of the Contractor hereunder. Plant or equipment owned or controlled by any one or combination of such entities shall be considered as owned or controlled by the Contractor for the purposes of the provisions of this contract.

IN WITNESS WHEREOF, the parties hereto have executed this contract as of the day and year first above written.

THE UNITED STATES OF AMERICA,

By .....

.....  
(Official title)

Two witnesses:

..... } Contractor.  
..... }

.....  
(Business address)



I, \_\_\_\_\_, certify that I am the secretary of the corporation named as contractor herein; that who signed this contract on behalf of the contractor, was then of said corporation; that said contract was duly signed for and in behalf of said corporation by authority of its governing body, and is within the scope of its corporate powers.

\_\_\_\_\_  
[ CORPORATE  
SEAL ]

### Questions

1. Given a list of contractors considered to be qualified to construct a large office building under a negotiated cost-plus-a-fixed-fee contract, how should a selection be made as to the award of the contract?

2. Under normal conditions, why would the amount of the fixed fee not be a major consideration in the award of the contract?

3. What factors should govern the amount of the fixed fee?

4. Under what conditions would a sliding scale of fees be advisable in lieu of one fixed fee, and what changes would be necessary in the wording of the cost-plus-a-fixed-fee contract to convert it to a sliding-scale-of-fees basis?

5. Explain the nature of changes in the work on a large dam which would justify changes in the amount of the contractor's fixed fee. What types of changes would not warrant changes in the fee?

6. Which of the following items of cost should be considered reimbursable and which are non-reimbursable under a cost-plus-a-fixed-fee contract?

- a. The salary of the construction superintendent.
- b. The salary of the concrete foreman.
- c. Cement, sand and gravel.
- d. The salary of the president of the contracting company.
- e. The cost of a new bulldozer.
- f. The rental of a steam shovel.
- g. The complete overhaul of a dragline at the end of the job.
- h. The salary of the contractor's chief cost accountant in his home office.
- i. Interest on funds borrowed by the contractor for use as working capital.

7. Write an article for a cost-plus-a-fixed-fee contract to cover the rental to be paid to the contractor for the use of his equipment. Base the amounts of rentals on the standard schedule of the Associated General Contractors reduced to eliminate the contractor's profit. Why should the contractor's profit be eliminated from equipment rental? How would the terms of this article differ from those of an agreement for the rental of equipment from a third party?

8. Write an article for a cost-plus-type contract covering reimbursement to the contractor of the costs in connection with the work. Consider both direct and indirect costs.

9. Write an article for a cost-plus-type contract providing for the contractor to receive a fixed fee based on the estimated cost of the work and containing the following additional provisions.

- a.* A ceiling price beyond which additional costs will not be reimbursed.
- b.* Payment to the contractor, in addition to the fixed fee, of 25 per cent of any saving in the total cost of the work as compared with the estimated cost.

# 7

## CONSTRUCTION INSURANCE

The many types of risk and liability in connection with construction work are matters of importance to the engineer. Most of these are the responsibility of the contractor, but the owner's interests are concerned, and the engineer is usually called upon for advice relative to insurance coverage. Moreover the contract and the specifications should be explicit as to types of insurance required of the contractor, and it should be equally definite in stating the risks to be assumed by the owner and to be covered by insurance obtained by him.

Under the law of torts, an independent contractor is liable for damages caused by his acts during construction operations, but in most instances it is advisable for the contract to require insurance against well-known hazards as additional financial protection to the owner. The satisfactory completion of construction work and the payment of all of the contractor's expenses for labor and materials in connection with the work normally are guaranteed by performance and payment bonds, but the risks of loss due to fire and to the operation of public liability and workmen's compensation laws are generally covered separately by insurance. Other hazards, such as storms, water leakage, and explosions, are likewise insurable.

**Fire Insurance.** The standard fire insurance policy obligates the insurance company to assume liability for fire damage under three classifications, namely, the building, household furniture, and stock and fixtures. For construction-contract purposes the first form is of primary interest inasmuch as it provides coverage for the building, additions, extensions and appurtenances, such as mechanical equipment, sidewalks, fences, and other permanent equipment. It should be noted that liability for loss of plans, specifications, and similar papers contained in the building is usually excluded from this form as is damage to foundations, unless special provision is made for such coverage. The standard

policy does not cover loss due to fire caused by storms, war damage, riots, strikes, theft in connection with fire, explosions, lightning, negligence of the insured, or change in hazard, as, for instance, alterations to a building making it less fire resistant. Special conditions and requirements may be written into the standard policy, however, by negotiation with the insurance company. The policy may cover liability for the full value of the property or any percentage of its full value. Partial loss in the latter case would be paid in full up to the fractional limit of the policy. Before fire insurance is purchased all exceptions and waivers in the company's standard agreement should be checked to make certain that the proper coverage is being obtained.

For new construction the builder's risk policy has been devised to provide insurance protection for the increasing value of the structure as construction progresses. The insured forwards monthly progress reports to the insurance company, and the premiums and the liability of the company are computed on the basis of the last progress report received. As in the standard policy, coverage may be obtained for the full value of the completed work or any fraction thereof. Under this form the insurance company assumes liability for fire damage to the work and to appurtenances, excepting foundations. All materials, supplies, equipment, construction plant, and temporary structures to be used in the construction are included. Tools, construction equipment, and machinery are also included when in the structure, in cars on side tracks on the premises, or in adjacent streets or alleys. The policy is operative only while the structure is under construction and not occupied.

To avoid the inconvenience of detailed monthly progress reports to the insurance company, builder's risk completed value policies may be obtained. Under this form the insurance is based on the entire completed value of the property with the provision of liability at any specific time for only the amount of the actual value the property bears at that date. The rates and premiums are based on average amount of liability during the construction period.

Standard fire insurance policies do not include liability for loss or damage due to demolition required by law or safety ordinances of a portion of a building remaining after a fire. An ordinary policy may be extended to cover this possibility, however. In a

similar manner such hazards as tornados, cyclones, hailstorms, lightning, riots, strikes, water leakage, and explosions may be included. Each of these risks in turn is accompanied by waivers, exceptions, and conditions in standard agreements and is subject to negotiation with the insurance company when the policy is written. Advice relative to fire insurance problems and to precautionary measures to prevent fires is available from the National Board of Fire Underwriters, an organization sponsored by the insurance companies in the interests of fire prevention.

Fire insurance rates vary with the locality, the fire-fighting facilities available, the types of construction, the preventative measures in operation, and, in the case of new construction, with the construction methods and fire precautions observed. It is necessary in each instance to consult representatives of fire insurance companies in order to determine rates for specific protection and the terms under which it is to be provided.

**Miscellaneous Forms of Property Damage Insurance.** In addition to fire there are possibilities of property damage due to numerous other causes, such as water leakage, explosions, riots, wind, cyclones, and earthquakes. Insurance protection against such risks may be obtained under individual policies or as endorsements on fire insurance policies including the builder's risk form. In addition, comprehensive all-purpose policies are written by some insurance companies to cover the combination of a number of different hazards. Like all insurance, these policies and endorsements are predicated on the probabilities of loss. Rates and premiums therefore are based on local conditions. In general, these policies provide for the insurance company to assume liability only for damages due directly to the hazard for which the policy is written, excluding possible damage incidental thereto, except by special agreement for its coverage. Burglary, theft, and robbery policies are also available if desired in connection with construction work.

**Marine and Inland Marine Insurance.** Marine insurance is designed to meet the risks of loss incurred through water transportation on the high seas. Policies are written in connection with loss of or damage to ships, ships' cargoes, and freight charges. This may be further subdivided into sea transportation and coast-wise or inland waterway transportation. With reference to construction work this form of insurance is chiefly of interest to

contractors transporting floating equipment, and materials, supplies, or machinery by ship. By a modification of marine insurance, designated as inland marine insurance, protection may be extended to property under other forms of transportation such as by railroad, motor truck, parcel post, and railway express. Under this type of policy, property and equipment of contractors may be insured against loss due to fire, storms, wrecks, and other risks while in transit on land carriers.

Inasmuch as bridges are related to transportation, bridge insurance is classified as the inland marine type. It is written in three forms, namely, bridge builder's risk, bridge property damage, and bridge use and occupancy insurance. The bridge builder's risk form covers damage to the structure, during construction, due to fire, lightning, floods, ice, collision, explosions, riots, vandalism, wind, tornados, and earthquakes. Other risks may be included by special agreement. Usually excluded are losses due to suspension of construction through operation of the law or governmental order, suspension, termination, or lapse of any license, permit, or lease, or by injunction. The amount of the insurance company's liability is proportional to the actual value of the work completed at the time of the loss and is based on the most recent report of the progress of the work. Coverage may be for the entire value of the completed work or any desired percentage thereof.

Bridge property damage insurance is written for a specific bridge at a specific location and is similar to the bridge builder's risk policy as to the liability assumed by the insurance company. In addition, loss due to collapse is included.

Bridge use and occupancy insurance protects the owner against loss due to inability to operate a bridge as a result of damage of the type covered by the bridge builder's risk policy. This form is of particular interest to owners of toll bridges and provides insurance for the actual loss suffered from the suspension of tolls less normal operating charges. Usually losses due to suspensions of less than seven days are deductible.

**Public Liability Insurance.** Extraordinary risks to the persons and property of others are inherent in construction work, even though such persons and property may not be directly associated with the work in progress. Under the laws of torts, any damages considered due to negligence become the responsibility

of those causing them. In construction work, the amounts of resultant damages may be large, and protection through public liability insurance is practically essential. Public liability may be direct in which the insured's own legal liability is involved; it may be contractual in which the insured assumes the legal liability of another by the terms of a contract; or it may be contingent and protective, which involves the indirect liability of the insured for the acts of others for which the law may hold him liable.

A construction contractor acting as an independent contractor and not as an agent of the owner is responsible for any damages incidental to the work being performed under the contract. This responsibility is applicable to adjacent property and to persons in the vicinity of the construction operations including persons on the site whether entitled to be there or not. Likewise the owner is liable for damages to others by reason of any defective condition, such as faulty construction, repair, maintenance, or operation of his own property. Furthermore, by reason of contingent liability, he may be held jointly liable for the acts of an independent contractor with whom he has entered into contract. That is to say, the owner may delegate by contract the responsibility for risks existing during construction operations, but he may not completely absolve himself of responsibility thereby. In a similar manner, an independent contractor may be held contingently liable for the acts of one of his subcontractors who is acting as an independent contractor and not as an agent of the prime contractor. A principal, of course, is fully liable for all damages committed by his agent while the agent is carrying out the obligations of the agency agreement. Hence, the usual construction contract should be accompanied by three types of public liability insurance, namely:

- a.* Contractor's liability insurance.
- b.* Owner's protective liability insurance.
- c.* Contractor's protective liability insurance.

**Contractor's Liability Insurance.** Under the contractor's liability policy the insured is protected against liability for injury to persons by reason of his construction operations. This policy may be extended to cover damage to the property of others as well. Under this type of policy, the insurance company assumes responsibility for any claims arising from accidental injury to or death of any person except employees of the insured and others

for whom the insured is liable under workmen's compensation laws. Property damage liability may arise from accidental damage to property including the loss of its use. Property owned, leased, rented, or used by the insured or any of his employees is excluded, however. That is to say, contractor's liability insurance applies only to persons and property not connected with the insured.

**Owner's Protective Liability Insurance.** An owner's protective liability policy is a form of public liability insurance in which the insurance company covers the owner's contingent liability for damages due to bodily injury, including death resulting therefrom, and property damage caused by accident arising from construction operations performed for the owner by independent contractors and subcontractors. This kind of insurance also protects the interest of the owner against liability which may be imposed upon him by law because of his supervisory acts or omission thereof in connection with the work performed by the general contractor and subcontractors.

While it is usual to hold the contractor primarily liable for his own operations, the owner also may be subjected to lawsuits, either singly or jointly with the contractor. Furthermore, consideration must be given to the possibility of default by the contractor in which case the owner may become fully liable. The protection provided by this form of insurance is similar to that of the contractor's protective liability insurance.

Where work is performed for an owner on a cost-plus-a-percentage or cost-plus-a-fixed-fee basis, the protection of the owner may be added by endorsement to the contractor's insurance at no additional premium charge. This eliminates the need for owner's protective liability insurance if the owner is satisfied that the contractor carries adequate limits of liability to protect both interests.

**Contractor's Protective Liability Insurance.** A contractor employing a subcontractor is subject to risks of contingent liability with respect to acts of the subcontractor in the same manner and to the same extent as the owner. Contractor's protective liability insurance covers the contractor for legal liability because of bodily injury, including death resulting therefrom and property damage caused by accidents arising out of operations performed for the contractor by independent subcontractors. The insurance



also protects the contractor against liability which may be imposed upon him by law for damages caused by accident and arising out of omissions or supervisory acts of the contractor in connection with work performed for him by independent subcontractors. Protection is also afforded for accidents (except accidents due to misdelivery) which occur after completion or abandonment of such operations and which arise out of pickup or delivery operations or the existence of tools, uninstalled equipment, and abandoned or unused materials. A claimant may sue not only the subcontractor and owner but also the general contractor for injuries sustained or for death resulting therefrom. If a subcontractor in turn sublets work, he would also need this type of protection.

**Contractual Liability Insurance.** It is not uncommon for the contractor to be required by a construction contract to save the owner harmless and to assume all the owner's liability including contingent liability for damage to persons and property arising from construction operations. This is an assumption of liability on the part of the contractor which is outside the scope of liability imposed by law. In view of the fact that the legal liability types of insurance previously discussed specifically exclude coverage for assumed liability, a special policy providing contractual liability insurance is required. Under these conditions, owner's protective liability insurance may not be necessary.

**Workmen's Compensation Insurance.** With the enactment of workmen's compensation laws which placed responsibility on employers for damages due to industrial accidents, it became evident that losses so heavy that they jeopardized an employer's financial stability were possible. To meet this hazard, the standard workmen's compensation and employers' liability insurance policy was devised. By this type of policy, the insurance company assumes the risk of an employer in consideration of the payment of a premium. The amount of the premium is determined on the basis of accident probability statistics which consider the location and type of work being performed and the number of workmen employed. Under most state laws, such insurance is made compulsory.\* Protection is furnished against losses resulting from personal injury or death of employees as imposed by the work-

\*An exception is made when an employer can qualify as a self-insurer, however.

men's compensation act and also losses due to legal liability for such losses as imposed by the employer's liability act.

The details of the coverage of workmen's compensation insurance vary somewhat with the law of the state involved. Also, special endorsements may be added to meet individual requirements. Typical of the latter is the coverage of occupational diseases which are not usually included. Also, the protection of subcontractors' employees as well as those of the prime contractor is a matter for special consideration.

**Provisions of the Law with Regard to Insurance.** An insurance policy is a conditional contract whereby the insurance company agrees to pay the insured or his designated beneficiary for a specified loss or liability, contingent on the occurrence of some event. Like all contracts the policy must meet the essential requirements as to agreement, lawful subject matter, consideration, competency of the contracting parties, and form in order to be valid. Its primary purpose is the payment of indemnity for loss, and, although it is enforceable in the case of negligence on the part of the insured, a loss resulting from an intentional act of the insured will usually invalidate the policy.

The insured must have an insurable interest as a condition to the contract, and the amount of insurance protection obtainable is limited to the valuation of the insurable interest. That is to say, one may not recover more than the loss suffered.

Under the insurance policy the company promises to protect the insured against a specified loss. The consideration of the contract is the payment by the insured of a stipulated premium. In the case of mutual insurance companies the consideration may also require the payment of assessments as well as the premium. Failure to pay the premium when due will usually mean that the insured automatically forfeits his rights under the policy. Some state statutes require the company to notify the insured when premium payments are due, and under this condition failure to pay the premium on time is not held to be cause for invalidating the policy unless such notification has been made.

In transactions relative to insurance policies the insurance company is usually represented by an agent, and the laws of agency are applicable. The agent has the authority to enter into contract for the company, and the company is bound by the acts and promises of its agent, within the scope of the authorized agency. It is

the responsibility of the insured to inform himself of any limitations or restrictions placed on the agent by the company. However, any fraudulent act, promise, or representation by the agent will bind the company even though not authorized by the company, provided that the act was within the apparent scope of the agency and that the insured was not a party to the act.

**State Supervision of Insurance Companies.** The laws of all states provide for the examination and supervision of insurance companies with regard to business methods, financial security, regulation of rates, licensing of brokers and agents, terms of policies, and like matters. State supervision is considered desirable as a means for the protection of purchasers of insurance and investors in insurance companies. Administrative control of state supervision is usually vested in a commissioner or superintendent who is authorized to administer the law in the best interests of the people. Thus he serves as a referee or arbiter whose general rulings and decisions have about equal weight to those of a judge in a court of law. Some states give the insurance commissioner the authority to intervene in disputes between an insurance company and an insured in connection with claims under insurance policies.

### Questions

1. In drawing the general contract for the construction of an office building, what insurance policies should the prime contractor be required to carry for the owner's protection? What policies should he carry of his own volition to protect his own interests? What insurance protection should the owner obtain?

2. The owners of a toll bridge insured the structure against collapse. The agent of the insurance company, believing that the occurrence of such an event was unlikely, did not report to his company that he had written the policy, and he retained the premiums paid by the owners. Later the bridge did collapse, and when the owners presented their claim the insurance company had no record of the policy. Who was liable for the loss?

3. What are the advantages of comprehensive insurance policies, such as builder's risk, in construction work?

4. When a number of risks such as fire, tornado and explosion are to be covered by insurance, what are the advantages to the insured of having all policies written by the same company?

## 8

### SURETY BONDS, PREQUALIFICATION, ARBITRATION

This chapter deals with some of the non-technical features of contracting practice which are intended to insure the satisfactory completion of the work. If the contractor were always competent, honest, and financially responsible and if the contract documents were always perfect, these questions would never arise. Unfortunately, this combination of conditions is improbable. Therefore, it is necessary to provide some means for the prevention or completion of defaulted contracts and for the arbitration or settlement of disputes which are costly and cause delays in the progress of the work.

**Surety Bonds.** Contractors are generally required to furnish surety bonds as a guarantee of the faithful performance of the contract obligations. Surety bonds are usually issued by a bonding company although private individuals may serve as sureties, or the contractor may furnish his own surety by depositing acceptable property or collateral with the owner. Surety bonds are the general rule, however, inasmuch as their cost is relatively low. There are three parties to the execution of a bond.

- a. The *principal* (contractor) in whose behalf the bond is written and whose performance is guaranteed.
- b. The *obligee* (owner) in whose favor the bond is written.
- c. The *surety* (bonding company) who acts as guarantor for the principal and who is obligated to make good to the obligee any default on the part of the principal.

Three common types of surety bonds are normally used in connection with competitive-bid contracts, namely, bid bonds, performance bonds, and payment bonds. Surety bonds are not often required with negotiated contracts since these are usually on a cost-plus basis in which the owner selects the contractor and assumes partial responsibility for the control of the work. For

contracts negotiated on a lump-sum or unit-price basis, however, it may be advisable to require payment bonds in order to protect the owner against loss arising from the contractor's possible failure to pay his bills in connection with the work.

**Bid Bond.** The bid bond is submitted with the proposal. It guarantees that the bidder will enter into the contract if his bid is accepted. In the event that the bidder should refuse to sign the contract in accordance with his bid, the surety is obligated to pay to the owner the damages caused thereby in the amount specified in the bond. Practice varies on the penal sum to be required in the bid bond from 5 to 10 per cent of the bid amount. The standard form of bid bond used by the U.S. Government stipulates that, if the approved bid is withdrawn and the contract refused, the government shall be paid the difference between the amount specified in the bid and the amount for which the government may procure the required work under the second-lowest acceptable bid.

A certificate of surety is similar in some respects to the bid bond. It accompanies the bid and guarantees that if the contract is awarded to the bidder the surety will furnish performance and payment bonds.

**Performance Bond.** This bond guarantees that the work will be completed as required by the contract. It is primarily a guarantee of ability and performance, but it may also include provision for payment of bills and protection against liens. Under government contracts this bond is usually executed in the full amount of the contract.

**Payment Bond.** This bond guarantees that the contractor will pay all bills and obligations incurred under the contract, thus rendering the owner harmless from claims and liens which might be filed after the completion of the work and after all payments had been made to the contractor. Under government contracts this bond usually is executed in the amount of one-half of the contract price. For private contracts the performance and payment bonds are frequently combined in one surety.

**Miscellaneous Types of Bonds.** Maintenance bonds guarantee the quality or maintenance cost of the construction work for a definite period of time. Labor and material bonds are designed to protect workmen, material dealers, and subcontractors. They are in effect a form of payment bond. Supply bonds guarantee

that the contractor will furnish materials and equipment required under supply contracts. Fidelity bonds guarantee the honesty of individuals, companies, or corporations. They may also guarantee the performance of obligations.

**The Surety Bond as a Contract.** A surety bond is explicitly a contract between the surety and the owner in which the surety promises to make good a deficiency on the part of the contractor, the obligations of the contractor being defined in the construction contract to which the surety is not a party. Construction contracts generally provide for changes and modifications as desired by the owner. Thus, in the case of changes, the surety may be placed in the position of being obligated by the contractual agreements of persons other than himself. This is contrary to the common law inasmuch as two contracting parties may not bind a third without his consent. Therefore, a change in the contract may discharge the bond and should never be undertaken without first obtaining the approval of the surety, unless the terms of the bond stipulate some other procedure. In this connection it should be noted that the standard performance bond for U.S. Government contracts provides for changes in the contract without advance permission by the surety. The surety thereby waives his rights under the common law in this respect. This is accomplished by making the contractor a joint venturer with the surety in the bond contract.

**Warranty.** A warranty is frequently required in construction contracts in connection with the furnishing of certain types of materials and equipment. By means of a warranty the contractor certifies that the material or equipment will perform as required. If the material or equipment so covered should fail to perform as required the contractor is liable to a suit for damages on the grounds of breach of warranty. A warranty promises results and implies that the contractor may have control over the sufficiency of the plans. If the owner retains control over the details of the plans, the warranty may not be enforceable. Warranties are usually required with the purchase of machinery, such as motors and pumps, and in connection with the use of certain processed materials where the designs are furnished by the vendor and the products are manufactured by him to meet the performance specifications. Warranties required under construction contracts constitute separate agreements and do not conflict with or duplicate

the functions of surety bonds. If desired, however, surety bonds may be made to guarantee the compliance of a warranty. This is usually required under U.S. Government contracts.

**Completion of Defaulted Contracts.** If a contractor fails to complete a contract the surety is called upon to finish the work. This he may elect to accomplish with his own forces, those of the defaulted contractor, or by letting a new contract for the uncompleted portion of the work. Furthermore, it is not unusual to include a provision for the owner or the surety to take over and use the contractor's equipment to complete the work in case of default by the contractor. If he so elects the surety may simply pay the penal amount and leave the responsibility for the completion of the work to the owner. Regardless of the method chosen, delays and extra expenses to the owner are to be expected. Therefore, it is desirable that the engineer exert every possible effort to avoid default. This may sometimes be accomplished by compromise on issues that arise during the course of the work or even by yielding on questions of interpretation of the contract when such action can be justified in the light of the implications of default.

**Bonding Practice for U.S. Government Contracts.** The standard forms for bid, performance, and payment bonds required for competitive bid contracts with the U.S. Government are reproduced herein as examples of good bonding practice. These forms are considered to be fair to all parties concerned. In all cases of construction contracts the bonds are executed in accordance with the following instructions.

### *EXAMPLES OF BOND FORMS*

#### **INSTRUCTIONS \***

1. This form shall be used for construction work or the furnishing of supplies, whenever a bond is required.

2. The surety on the bond for any bid or for the performance of the contract may be any corporation authorized by the Secretary of the Treasury to act as surety, or two responsible individual sureties. Individual sureties shall justify in sums aggregating not less than double the penalty of the bond.

\*U.S. Government Form 24. Instructions for the execution of construction bonds.

3. A firm, as such, will not be accepted as a surety, nor a partner for copartners or for a firm of which he is a member. Stockholders of a corporate principal may be accepted as sureties provided their qualifications as such are independent of their stock holdings therein. Sureties, if individuals, shall be citizens of the United States, except that sureties on bonds executed in any foreign country, the Canal Zone, the Philippine Islands, Porto Rico, Hawaii, Alaska, or any possession of the United States, for the performance of contracts entered into in these places, need not be citizens of the United States, but if not citizens of the United States shall be domiciled in the place where the contract is to be performed.

4. The name, including full Christian name, and residence of each individual party to the bond shall be inserted in the body thereof, and each such party shall sign the bond with his usual signature on the line opposite the scroll seal, and if signed in Maine, Massachusetts, or New Hampshire, an adhesive seal shall be affixed opposite the signature.

5. If the principals are partners, their individual names shall appear in the body of the bond, with the recital that they are partners composing a firm, naming it, and all the members of the firm shall execute the bond as individuals.

6. The signature of a witness shall appear in the appropriate place, attesting the signature of each individual party to the bond.

7. If the principal or surety is a corporation, the name of the State in which incorporated shall be inserted in the appropriate place in the body of the bond, and said instrument shall be executed and attested under the corporate seal as indicated in the form. If the corporation has no corporate seal the fact shall be stated, in which case a scroll or adhesive seal shall appear following the corporate name.

8. The official character and authority of the person or persons executing the bond for the principal, if a corporation, shall be certified by the secretary or assistant secretary, according to the form attached thereto. In lieu of such certificate there may be attached to the bond copies of so much of the records of the corporation as will show the official character and authority of the officer signing, duly certified by the secretary or assistant secretary, under the corporate seal, to be true copies.

9. Each individual surety shall justify, under oath, according to the form appearing on the bond, before a United States commissioner, a clerk of a United States court, a notary public, or some other officer having authority to administer oaths generally. If the officer has an official seal it shall be affixed, otherwise the proper certificate as to his official character shall be furnished. Where citizenship is not required, as provided in paragraph 3 of these Instructions, the affidavit may be amended accordingly.

10. The certificate of sufficiency shall be signed by an officer of a bank or trust company, or by a judge or clerk of a court of record, a United States district attorney or commissioner, a postmaster, a collector or deputy collector of internal revenue, or any other officer of the United States acceptable to the department or establishment concerned.

11. The date of the bond must not be prior to the date of the instrument for which it is given.



# 206 SURETY BONDS, PREQUALIFICATION, ARBITRATION

U.S. Standard Form No. 24  
Approved by the President  
Nov. 19, 1926

## STANDARD GOVERNMENT FORM OF BID BOND

(CONSTRUCTION OR SUPPLY)

KNOW ALL MEN BY THESE PRESENTS, That we,

(See Instructions 4, 5, and 7)

as PRINCIPAL, and

as SURETY,

(See Instructions 2, 3, 4, and 7)

are held and firmly bound unto the United States of America, hereinafter called the Government, in the penal sum of dollars lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the principal has submitted the accompanying bid, dated , 19 , for

Now, THEREFORE, if the principal shall not withdraw said bid within the period specified therein after the opening of the same, or, if no period be specified, within sixty (60) days after said opening, and shall within the period specified therefor, or, if no period be specified, within ten (10) days after the prescribed forms are presented to him for signature, enter into a written contract with the Government, in accordance with the bid as accepted, and give bond with good and sufficient surety or sureties, as may be required, for the faithful performance and proper fulfillment of such contract, or in the event of the withdrawal of said bid within the period specified, or the failure to enter into such contract and give such bond within the time specified, if the principal shall pay the Government the difference between the amount specified in said bid and the amount for which the Government may procure the required work and/or supplies, if the latter amount be in excess of the former, then the above obligation shall be void and of no effect, otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above-bounden parties have executed this instrument under their several seals this day of

, 19 , the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

[Signatures and Affidavits]

U.S. Standard Form No. 25 (Revised)  
Approved by the Secretary  
of the Treasury  
Sept. 16, 1935

# PERFORMANCE BOND

(CONSTRUCTION OR SUPPLY)

KNOW ALL MEN BY THESE PRESENTS, That we,

(See Instructions 4, 5, and 7)

as PRINCIPAL, and

as SURETY,

(See Instructions 2, 3, 4, and 7)

are held and firmly bound unto the United States of America, hereinafter called the Government, in the penal sum of \_\_\_\_\_ dollars for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the principal entered into a certain contract, hereto attached, with the Government, dated \_\_\_\_\_, 19 , for

Now, THEREFORE, If the principal shall well and truly perform and fulfill all the undertakings, covenants, terms, conditions, and agreements of said contract during the original term of said contract and any extensions thereof that may be granted by the Government, with or without notice to the surety, and during the life of any guaranty required under the contract, and shall also well and truly perform and fulfill all the undertakings, covenants, terms, conditions and agreements of any and all duly authorized

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modifications of said contract that may hereafter be made, notice of which modifications to the surety being hereby waived, then, this obligation to be void; otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above-bounden parties have executed this instrument under their several seals this \_\_\_\_\_ day of \_\_\_\_\_, 19\_\_\_\_, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

[Signatures and Affidavits]

U.S. Standard Form No. 25-A  
Approved by the Secretary  
of the Treasury  
Sept. 16, 1935

### PAYMENT BOND

(CONSTRUCTION)

Pursuant to the Act of Congress, Approved August 24, 1935  
(49 Stat. 793; 40 U.S. Code §270a.)

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KNOW ALL MEN BY THESE PRESENTS, That we,

(See Instructions 4, 5, and 7)

as PRINCIPAL, and

as SURETY,

(See Instructions 2, 3, 4, and 7)

are held and firmly bound unto the United States of America, hereinafter called the Government, in the penal sum of \_\_\_\_\_ dollars for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the principal entered into a certain contract, hereto attached, with the Government, dated \_\_\_\_\_, 19\_\_\_\_, for

NOW, THEREFORE, If the principal shall promptly make payment to all persons supplying labor and material in the prosecution of the work provided for in said contract, and any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the surety being hereby waived, then this obligation to be void; otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above-bounden parties have executed this instrument under their several seals this \_\_\_\_\_ day of \_\_\_\_\_, 19\_\_\_\_, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

[Signatures and Affidavits]

### *PREQUALIFICATION OF CONTRACTORS*

The necessity to advertise for bidders, to accept bids from all who are inclined to compete, and to award contracts to the lowest responsible bidder introduces problems in the awarding of contracts for public works which are not encountered in private construction where the list of bidders may be selected without restriction. For a bidder to establish responsibility under these conditions usually means the furnishing of the required surety and a record free from defaults or proved dishonesty. Thus incompetent and overextended contractors and those with inadequate financial resources may be placed more or less on an equal basis with responsible bidders in the competition for the award of a contract. Although bonding companies ordinarily exercise care in providing bonds for contractors, it should be noted that the ability of a contractor to obtain bond does not necessarily indicate competency or financial responsibility.

The employment of an unqualified contractor usually leads to difficulties during the operation of the contract. Also, slow progress, unsatisfactory quality of work, and excessive costs may result. Moreover, incompetency is one very important factor in contract defaults which always cause inconvenience, delays, and extra cost to the owner. The Bureau of Public Roads estimated that over 60 per cent of the cost of delays and unsatisfactory

progress on federal aid road projects was due to poor management and inadequate equipment. Likewise, a large surety company estimated that 75 per cent of the cost of losses sustained by it through defaulted contracts was due to inadequate financial responsibility, overextension, and incompetency.\* Losses incurred in this manner are, of course, passed along to the public in public works and to the owner in private construction projects. To avoid or reduce these difficulties the prequalification of bidders has been recommended.

The purpose of prequalification is to determine before a contractor is allowed to bid whether he is responsible and competent to satisfactorily complete a given construction contract. In some instances the prequalification procedure is sufficiently comprehensive that it is considered safe to reduce the amount of surety bonds, or to omit them altogether, in the award of contracts, it being assumed that all unqualified contractors are eliminated from the approved list of bidders. When carried to this extent, a direct reduction in construction costs results inasmuch as the cost of surety is reflected in the contractor's bid.

**Prequalification Procedure.** Prequalification procedure requires the contractor to submit a formal application to bid. The application contains sufficient information, usually in the form of answers to a questionnaire, to determine the contractor's competency and fitness to perform the contemplated work. The application should contain detailed data on the contractor's past experience, current work, financial status, quality of organization, and available plant and equipment. A consideration of these factors will usually eliminate unfit contractors from the list of those permitted. For instance, the value of contracts completed in the preceding five years is a measure of a contractor's average annual capacity. The difference between this amount and the value of incomplete contracts in progress will indicate his available capacity for new work. If his available capacity is not at least equal to the estimated value of the new contract, his organization should be closely examined to determine his ability to expand to meet the additional load. Likewise, his financial condition should be carefully examined in the light of the estimated amount

\* Present Status of Prequalification," by Robert B. Brooks, *Civil Engineering*, January, 1931.

of working capital required for the proposed work, and his past experience in the type of work in question should be of appropriate quality.

**Example of a Prequalification Questionnaire**

1. Name of firm; state whether individual, partnership, corporation, or joint venture. Give date of organization, the state in which incorporated, and names and addresses of officers or partners.

2. Official address.

3. How many years has your firm been in business as a general contractor under your present business name?

4. List by years the contracts completed during the past five or ten years, giving the character of work and contract amounts.

5. Amount of uncompleted work on contracts now in progress. List the total value of each contract, percentage uncompleted, estimated date of completion, and value of uncompleted portion.

6. Financial resources available as working capital for new work. State both cash on hand and sources of credit. Attach recent financial statement and letters from banks regarding credit.

7. List items of plant and equipment suitable and in good condition which can be made available for new work; state whether owned by you, where located, and, if not owned by you, what assurance you have that the equipment will be available when needed. Also give the total present value of available plant.

8. List of officials and key personnel who would devote full or part time to a new contract. Give name title, age, experience, and salary of each.

9. Knowledge of local conditions; transportation facilities, material and labor markets, living conditions for workmen and families, etc.

10. To what extent would you expect to employ subcontractors?

11. Does your organization include men experienced in securing cooperation of materials dealers in prompt filling of orders, and in securing cooperation of labor? Give particulars.

12. Have you ever failed to complete any work awarded to you? If so, give particulars.

13. Has an officer or partner of your firm ever been an officer or partner of some other organization that failed to complete a construction contract? If so, give particulars.

14. Has your firm ever engaged in litigation for the settlement of claims or disputes arising out of a construction contract? If so, give particulars.

**Advantages and Disadvantages of Prequalification.** The prequalification of contractors is still a somewhat controversial matter although the general consensus of opinion among both engineers and contractors appears to be that it is very desirable. It is required by law for public works projects in several states and has been adopted by several federal agencies. The legality of prequalification seems to be definitely established by rulings of various courts.

Some of the obvious advantages of prequalification are that lists of competent bidders may be established in advance when there is sufficient time to investigate contractor's qualifications. When all bidders are qualified, the contract is simply awarded to the lowest bidder, and the public official who awards the contract is saved the embarrassment of rejecting a low bid from an unqualified bidder. Contractors are saved the time and expense of preparing bids for work in which they are unqualified by inexperience and lack of financial or other resources. Failures and defaults of contracts during construction are minimized by the elimination of unfit contractors which results in a saving of time and cost of construction work.

Opponents of prequalification object that the questionnaires are too complicated for small contractors, many of whom have incomplete records; that the procedure requires an undue expenditure of time; that it places unlimited authority on public officials and offers an opportunity for favoritism; that it restricts competition to the large and rich contractors; and that it tends to eliminate young contractors who are starting in business. It is sometimes contended that financial statements and other details of a contractor's business or organization are personal and private matters and it is unconstitutional to require that they be made public in a prequalification statement.

**Bureau of Contract Information.** The Associated General Contractors of America has approved and sponsored the adoption of prequalification of contractors because of its benefits to all parties in construction work. In 1929 this organization established a Bureau of Contract Information with headquarters at 1420 New York Ave., N.W., Washington, D. C. The objective

of the Bureau of Contract Information is to study the performance records of every general contractor in the United States with the view to eliminating irresponsibility in the field of competition in the construction industry through the discouragement of the award of contracts to irresponsible bidders. This bureau is a non-profit fact-finding organization which cooperates with those responsible in the award of construction contracts.

### *ARBITRATION OF DISPUTES*

Arbitration is a procedure whereby contracting parties may submit a dispute to an impartial board of experts for decision as an alternative to a suit in a court of law. By this method, it is possible to avoid many of the legal formalities, delays, and expenses which result from litigation. Arbitration may be adopted for the settlement of a controversy at any stage of the performance of a contract by agreement of the contracting parties, or the original contract may contain a provision for the settlement of all disputes by arbitration during the life of the contract. If the contract provides for arbitration the requirement is valid and enforceable under the laws of most states and the decision of the arbitrators properly entered in a court has about the same strength as that of a judgment in a court of law and is subject to all the provisions of the law relative to a judgment.

In states which do not have arbitration laws the decision is valid only in so far as it is acceptable by both parties. If one party is dissatisfied with the decision, he may still resort to a lawsuit even though he signed the contract providing for arbitration. That is to say, every party to a contract has the right under the common law to a hearing in the appropriate court if he has a grievance, and no provision in the contract can cause the forfeiture of this constitutional right against his will.

**Arbitration Procedure.** Many states have laws which govern the procedure to be followed in submitting any dispute to arbitration. Where these do not exist, it is advisable to specify a definite procedure, such as the Code of Arbitration Practice and Procedure of the American Arbitration Association. The proceedings may be conducted informally or, if desired, may be under the supervision of a court. In general, arbitration requires the following procedure.



- a. The agreement to arbitrate.
- b. The submission.
- c. Selection of arbitrators.
- d. The hearing.
- e. The award.
- f. The confirmation.

**The Arbitration Agreement.** The agreement to arbitrate disputes may be included in any contract, and it becomes effective for all disputes when the agreement is signed. In the case of a dispute under a contract in which provision for arbitration has not been included, a special or supplemental agreement may be negotiated if desired, providing for arbitration of all existing and future disputes during the life of the contract, or it may be restricted to a specific controversy only. In either event, the agreement must be in writing, signed by both parties, and should specify the procedure to be adopted, as in the following example.

#### ARBITRATION PROCEDURE RECOMMENDED BY JOINT CONFERENCE ON STANDARD CONSTRUCTION CONTRACTS

**Arbitration.** (a) Demand for Arbitration. Any decision of the Engineer which is subject to arbitration shall be submitted to arbitration upon the demand of either party to the dispute.

The Contractor shall not cause a delay of the work because of the pendency of arbitration proceedings, except with the written permission of the Engineer, and then only until the arbitrators shall have an opportunity to determine whether or not the work shall continue until they decide the matters in dispute.

The demand for arbitration shall be delivered in writing to the Engineer and the adverse party, either personally or by registered mail to the last known address of each, within ten days of the receipt of the Engineer's decision, and in no case after final payment has been accepted except as otherwise expressly stipulated in the Contract Documents. If the Engineer fails to make a decision within a reasonable time, a demand for arbitration may be made as if his decision had been rendered against the demanding party.

(b) Arbitrators. No one shall be nominated or act as an arbitrator who is in any way financially interested in this Contract or in the business affairs of the owner, or the Contractor, or the Engineer, or otherwise connected with any of them. Each arbitrator shall be a person in general familiar with the work or the problem involved in the dispute submitted to arbitration.

Unless otherwise provided by controlling statutes, the parties may agree upon one arbitrator; otherwise there shall be three, one named in writing,

by each party to this Contract, to the other party, and the third chosen by those two arbitrators, or if they should fail to select a third within fifteen days, then he shall be appointed by the presiding officer, if a disinterested party, of the Bar Association nearest to the location of the work.\* Should the party demanding arbitration fail to name an arbitrator within ten days of his demand, his right to arbitration shall lapse. Should the other party fail to name an arbitrator within said ten days, then said \* presiding officer shall appoint such arbitrator within ten days, and upon his failure so to do then such arbitrator shall be appointed on the petition of the party demanding arbitration by a judge of the Federal Court in the district where such arbitration is to be held.

The said \* presiding officer shall have the power to declare the position of any arbitrator vacant by reason of refusal or inability to act, sickness, death, resignation, absence or neglect. Any vacancy shall be filled by the party making the original appointment, and unless so filled within five days after the same has been declared, it shall be filled by the said \* presiding officer. If testimony has been taken before a vacancy has been filled, the matter must be reheard unless a rehearing is waived in the submission or by the written consent of the parties.

If there be one arbitrator his decision shall be binding; if three, the decision of any two shall be binding in respect to both the matters submitted to and the procedure followed during the arbitration. Such decision shall be a condition precedent to any right of legal action.

(c) Arbitration Procedure. The arbitrators shall deliver a written notice to each of the parties and to the Engineer, either personally or by registered mail to the last known address of each, of the time and place for the beginning of the hearing of the matters submitted to them. Each party may submit to the arbitrators such evidence and argument as he may desire and the arbitrators may consider pertinent. The arbitrators shall, however, be the judges of all matters of law and fact relating to both the subject matters of and the procedure during arbitration and shall not be bound by technical rules of law or procedure. They may hear evidence in whatever form they desire. The parties may be represented before them by such person as each may select, subject to the disciplinary power of the arbitrators if such representative shall interfere with the orderly or speedy conduct of the proceedings.

Each party and the Engineer shall supply the arbitrators with such papers and information as they may demand, or with any witness whose movements are subject to their respective control, and upon refusal or neglect to comply with such demands the arbitrators may render their decision without the evidence which might have been elicited therefrom and the absence of such evidence shall afford no ground for challenge of the award by the party refusing or neglecting to comply with such demand.

The submission to arbitration (the statement of the matters in dispute between the parties to be passed upon by the arbitrators) shall be in writing duly acknowledged before a notary. Unless waived in writing by both

\*To provide some other agency for appointing arbitrators strike out reference to presiding officer of the Bar Association and insert desired designation. In the vicinity of New York, the Arbitration Society of America, Inc., and the Chamber of Commerce of the State of New York have Arbitration Committees which often act in this capacity.

parties to the arbitration, the arbitrators, before hearing testimony, shall be sworn by an officer authorized by law to administer an oath, faithfully and fairly to hear and examine the matters in controversy and to make a just award according to the best of their understanding.

The arbitrators, if they deem the case demands it, are authorized to award to the party whose contention is sustained such sums as they shall consider proper for the time, expense and trouble incident to the arbitration, and if the arbitration was demanded without reasonable cause, damages for delay and other losses. The arbitrators shall fix their own compensation, unless otherwise provided by agreement, and shall assess the costs and charges of the arbitration upon either or both parties.

The award of the arbitrators shall be in writing and acknowledged like a deed to be recorded, and a duplicate shall be delivered personally or by registered mail, forthwith upon its rendition, to each of the parties to the controversy and to the Engineer. Judgment may be rendered upon the award by the Federal Court or the highest State Court having jurisdiction to render same.

The award of the arbitrators shall not be open to objection on account of the form of the proceedings or the award, unless otherwise provided by the controlling statutes. In the event of such statutes providing on any matter covered by this Article otherwise than as hereinbefore specified, the method of procedure throughout and the legal effect of the award shall be wholly in accord with said statutes, it being the intention hereby to lay down a principle of action to be followed, leaving its local application to be adapted to the legal requirements of the jurisdiction having authority over the arbitration.

The Engineer shall not be deemed a party to the dispute. He is given the right to appear before the arbitrators to explain the basis of his decision and give such evidence as they may require.

**The Submission.** When a dispute arises on work under a contract in which an arbitration agreement is in force, the first step towards a settlement by arbitration is the preparation of the submission which is a statement of the matters in dispute and an agreement between the contracting parties to submit the dispute, either in part or in its entirety, to arbitration as provided by the arbitration agreement. The submission must be in writing and signed by both parties. In the case of a corporation, only the officers authorized to sign contracts may sign the submission. In some states, the submission must be reviewed by the court which settles all questions as to its validity. Invalidity of the submission, if discovered at a later date, may be sufficient cause for the court to vacate the award of the arbitration upon the appeal of one of the disputants. Therefore, it is essential that the submission conform to all requirements of the law with regard to validity.

The submission defines the scope of the arbitration, the time within which the award is to be made, and the rules of procedure to be followed. The latter will be the general rules in common usage, such as those of the American Arbitration Association and, in addition, any special rules agreed upon by the disputants to meet the requirements of the particular dispute.

**Selection of Arbitrators.** The board of arbitrators may consist of one member who will act as an umpire, or, more frequently, each party selects one member, and the two so chosen will select an independent third member. In selecting arbitrators, it is of primary importance that they be qualified technically in the subject matter of the dispute and also that they be familiar with the arbitration procedure and the laws under which it is to be conducted. The arbitrators should be impartial persons with known integrity. They should not be financially interested in the contract or in the business affairs of either of the parties to the dispute. The American Arbitration Association maintains a national panel from which qualified arbitrators from every profession can be drawn. Selections from this panel should insure impartial arbitration by arbitrators who have no personal interest in the dispute or its outcome.

Disinterested engineers, architects, and contractors are frequently called upon to act as arbitrators in construction disputes because of their technical and practical knowledge of construction work. It is important to note, however, that anyone acceptable to the disputants may serve as an arbitrator, and no particular qualifications are required by law other than the requirement that the arbitrators shall act fairly and make a just award.

Before the arbitration proceedings begin, the arbitrators are sworn to hear and examine all evidence in the dispute and to make a fair award to the best of their ability. There can be no liability to an arbitrator because of a mistake in judgment, however, although he might be held liable for damages in the case of proved fraud or misconduct.

**The Hearing.** In conducting the hearing the arbitrators have the power to summon witnesses, records, documents, and other evidence as in a lawsuit. Testimony may be taken under oath subject to examination, cross-examination, and re-examination. The complaining party who initiated the arbitration submits his testimony supported by witnesses, and the defending party is

entitled to cross-examine. Likewise, the evidence of the defending party is submitted and subjected to cross-examination. After the submission of all evidence, both parties may be permitted to summarize the arguments in support of their respective contentions. At any time during the proceedings the arbitrators or the parties to the dispute may apply to the court for the determination of any questions of law.

**The Award.** The award representing the decision of the arbitrators must be in writing, signed by the arbitrators or a majority of them, and a signed copy must be delivered to each of the parties. The award must be confined to the scope of the submission and must deal with all elements of the dispute so submitted. It is not necessary, however, to show how the conclusions as to law and fact were arrived at; a simple announcement of the decisions is sufficient. However, it is customary to state concisely the findings of fact and law pertaining to the dispute. The conclusions should be clear so that each party will know his rights and obligations, and there should be no conditions or reservations in the award which might be subject to further controversy. Needless to say, the award may neither direct nor enable any party to do an illegal act.

**The Confirmation.** In most states any party to an arbitration may apply to the court for an order confirming the award at any time within one year after the award is made. The court must then issue an order either confirming, correcting or vacating the award. This court order has the same force and effect as the judgment in a court of law. Upon the filing of a request for confirmation of award, the opposing party must be notified in writing before the hearing. He has the right to request that the award be vacated or corrected if he has sufficient evidence to show that the decision of the arbitrator's was illegal or in error.

The court may vacate an arbitration award if it can be shown that the arbitrators were guilty of collusion, fraud, or partiality, if they refused to hear material evidence, or if they were otherwise guilty of misconduct which adversely affected the rights of any party. An award may be corrected by the court on the grounds of mistakes and miscalculations in the evidence or where the award is contrary to the law. In lieu of vacating or correcting the award, the court may require a rehearing of the arbitration.

**The Engineer as an Arbitrator.** The basic concept in arbi-

tration is that experts in the field of the dispute shall be chosen as arbitrators; thus the engineer is fitted by professional training and experience to serve in this capacity when controversies arise from construction contracts. Likewise, architects and contractors make excellent arbitrators when the dispute lies in their particular fields of knowledge. It should be noted, however, that technical knowledge alone is not enough to qualify an engineer as an arbitrator. It is necessary that he inform himself on the law under which the arbitration is to be held and the rules of procedure to be followed in collecting evidence and in arriving at a decision. Otherwise he may find himself confused by technicalities during the proceedings, or his decision may be vacated by the court because of his failure to comply with some requirement of the law.

**The Advantages of Arbitration.** By accepting arbitration in lieu of litigation, many advantages result to both the owner and the contractor in the event of a dispute. Large court costs are avoided, and delays due to crowded dockets are eliminated. Fair and intelligent decisions are to be expected inasmuch as the arbitrators are selected for their expert knowledge of the subject. Decisions based on legal technicalities are avoided, and the presentation of evidence is not hampered by legal restrictions as may occur in court procedure. Settlements of disputes by arbitration are usually amiable and result in no interference or delays in the prosecution of the work.

### Questions

1. What is the purpose of a bid bond? a performance bond? a payment bond?
2. Explain the contract relationships between the principal, the obligee, and the surety in the case of a surety bond.
3. Under what conditions may a change order under a construction contract invalidate a surety bond and relieve the surety of responsibility?
4. Explain the difference between a surety bond and a warranty.
5. How may the information obtained from a prequalification questionnaire, such as that on page 211, be used to determine a contractor's fitness to perform construction work?
6. What objectionable types of contractors may be eliminated by the prequalification procedure?
7. What general class of disputes under construction contracts may be settled by arbitration? Can a dispute on a subject covered by statute law be settled by arbitration?

## 220 SURETY BONDS, PREQUALIFICATION, ARBITRATION

8. Why is arbitration generally considered more satisfactory than litigation as a method for settling disputes under construction contracts?

9. Why is arbitration not acceptable to the United States Government in connection with government construction contracts?

10. A contractor had furnished a payment bond in connection with his undertaking to construct certain dwelling units for the United States Government. He placed an order for some necessary building materials with Materialman A. Materialman A filled the order after purchasing the materials from Materialman B. A was paid in full by the prime contractor, but A failed to pay B in full. B thereupon brought suit on the bond. Was the surety liable for the debt? Was B entitled to a mechanic's lien on the dwelling units? (See *Engineering News-Record*, August 21, 1947, p. 92.)

# 9

## CONTRACTS FOR ENGINEERING AND ARCHITECTURAL SERVICES

As in the case of the construction contractor the relationships between the client and the engineer or architect are of a contractual nature and should be set forth clearly in a written agreement. The contract should be of the negotiated type inasmuch as competitive bidding is considered unprofessional by engineers and architects. Under the usual terms of engineering contracts the engineer acts as the client's agent although agency may be avoided, if desired, by a stipulation in the contract that the engineer is to act as an independent contractor and not an agent.

**Services to Be Rendered.** The services required of the engineer will depend on the size and complexity of the work, the client's facilities along technical lines, and the basis on which the fee is determined. The following schedule of services are those usually required for general engineering purposes where both design and supervision of construction are required.

*a.* Preliminary surveys and supervision of explorations and borings.

*b.* Preparation of designs, drawings, and specifications.

*c.* Preparation of bid forms and assistance in the preparation of contract forms.

*d.* Estimates of quantities and costs.

*e.* Assistance in obtaining and analyzing bids and letting contracts.

*f.* Checking of shop and working drawings furnished by contractors.

*g.* Supervision of mill and shop inspections and tests.

*h.* Field layout, supervision, and inspection of the work during construction.

*i.* Progress and final estimates and reports.



j. Issuance of certificates for progress and final payments to contractors.

k. Revision of contract drawings to show changes introduced during the progress of the work.

**Types of Contracts.** Excepting the omission of the element of competitive bidding, contracts for engineering and architectural services are closely analogous to those for construction. Like construction contracts they are generally designated by the method used in arriving at the amount of the compensation. The types of engineering contracts in common usage are as follows.

*a. Fee Based on a Percentage of the Actual Net Construction Cost.* This type of contract is preferred by most engineers. It has the advantage that the client pays and the engineer receives compensation in direct proportion to the work performed and that adjustments in the engineer's fee to cover changes in construction are provided for automatically without additional contract procedure in so far as the engineering contract is concerned. The principal disadvantage is that the client does not know the exact cost of the engineering work when he signs the contract, and thus he does not know the extent of his obligations. Another objection occasionally raised is that the engineer may deliberately inflate the cost of the work in order to increase his own fee proportionately. Needless to say such practice would be extremely unprofessional if not actually fraudulent and would not be tolerated by ethical engineers.

*b. Lump-Sum Fee Based on a Percentage of the Estimated Construction Cost.* This form has the advantage that the cost of engineering work is known definitely in advance. It has the disadvantage, however, that errors in the estimated cost are reflected in the engineer's fee. Furthermore, each change order on the construction contract indicates the necessity for a corresponding change in the engineering contract.

*c. Cost Plus a Fixed Fee.* Under the preceding types of contracts the fee covers the engineer's normal costs and operating expenses in connection with the work and his profit. The cost-plus-a-fixed-fee type provides a fee for profit only since all costs in connection with the work, including overhead expenses, are reimbursed by the client. The fee is based on the estimated con-

struction cost and remains fixed regardless of any variation between the estimated and the actual costs. This type of contract has many advantages when the scope of the engineer's services cannot be accurately determined in advance, as in the case of alteration work and projects for which the client's requirements are not definitely established. Its disadvantages lie in the multiplicity of accounting records necessary to determine the engineer's true costs and in the difficulty in segregating costs when more than one project is being handled in the engineer's office concurrently.

*d. Fee Based on a Time Rate.* Contracts drawn on this basis may be for full- or part-time work and may provide for complete engineering services inclusive of assistants and overhead. More frequently, however, this type of contract is used for personal services only as, for instance, consultation and advisory services. The fee is usually determined on a per diem basis although hourly, monthly, and annual rates are sometimes used.

**Essentials of the Contract.** In most instances the contract is drawn as a formal legal document similar to those used for construction purposes. Many engineers, however, prefer to set forth the desired services and obligations in the form of a letter proposal which becomes a contract when accepted and signed by the client. The selection of form is a matter of personal preference since the two types are equally binding. The American Society of Civil Engineers considers that any contract or letter agreement for engineering services should state the following essential provisions.\*

*a.* Date and execution of the agreement.

*b.* Names and descriptions of the two parties to the agreement with their addresses; if a corporate body, the legal description of the incorporation. If the client is a commission or public body, state the authority under which it acts.

*c.* Description in brief but precise language of the work to be executed for which the agreement is drawn.

*d.* Brief but clear statement of the quantities and limitations of the work to be performed.

*e.* Statement of the character or the work to be furnished by the engineer to the client, as well as the limitations.

\* *Manual of Engineering Practice, No. 5, American Society of Civil Engineers.*

*f.* Statement of the obligations of the client to the engineer as affecting the work to be executed.

*g.* Provision as to the ownership of plans and ideas and as to the copyright, if any is desired.

*h.* Provisions, if any, as to termination of service at dates before final completion together with a statement as to penalty for such termination to be paid by the client to the engineer. If the project involves engineering studies and uncertain procedure thereafter, provision should be inserted for definite payments in case of the abandonment or indefinite postponement of the project.

*i.* Guarantees between the parties, if any such provisions are desired.

*j.* Money consideration for the work to be executed, including times and methods of payments on account; retaining fees; interim payments, both for personal service and expenses; and final payment in full settlement.

*k.* Statement of any other consideration in payment for services rendered, other than cash payments.

*l.* Statement when work is to be commenced and when concluded, if such provisions and obligations are required.

*m.* Arbitration clause.

**Determination of the Fee.** The amount of the engineer's fee will depend upon the cost and complexity of the work and the scope of the services required. The previous experience and performance record of the engineer also may be factors. The chart on page 226 shows graphically the schedules of fees recommended by the American Society of Civil Engineers.\* The schedules were prepared for contracts in which the fee is determined as a percentage of the actual net cost of the construction work, but they are equally applicable in cases where a lump-sum fee is to be used, based on the estimated construction cost. For contracts drawn on the cost-plus-a-fixed-fee basis, the fee should be from one-fourth to one-third of those shown, the larger percentage being applicable to the smaller projects. It is noted that the fees indicated are intended to cover the following services.

\* *Manual of Engineering Practice, No. 5*, American Society of Civil Engineers.

Preliminary investigations.

Assistance in application for federal funds, when required.

Preparation of designs, plans, and specifications.

Estimate of quantities and costs.

Assistance in securing bids.

Analyses of bids.

Assistance in letting contracts.

Checking shop and working drawings.

Consultation and advice during construction.

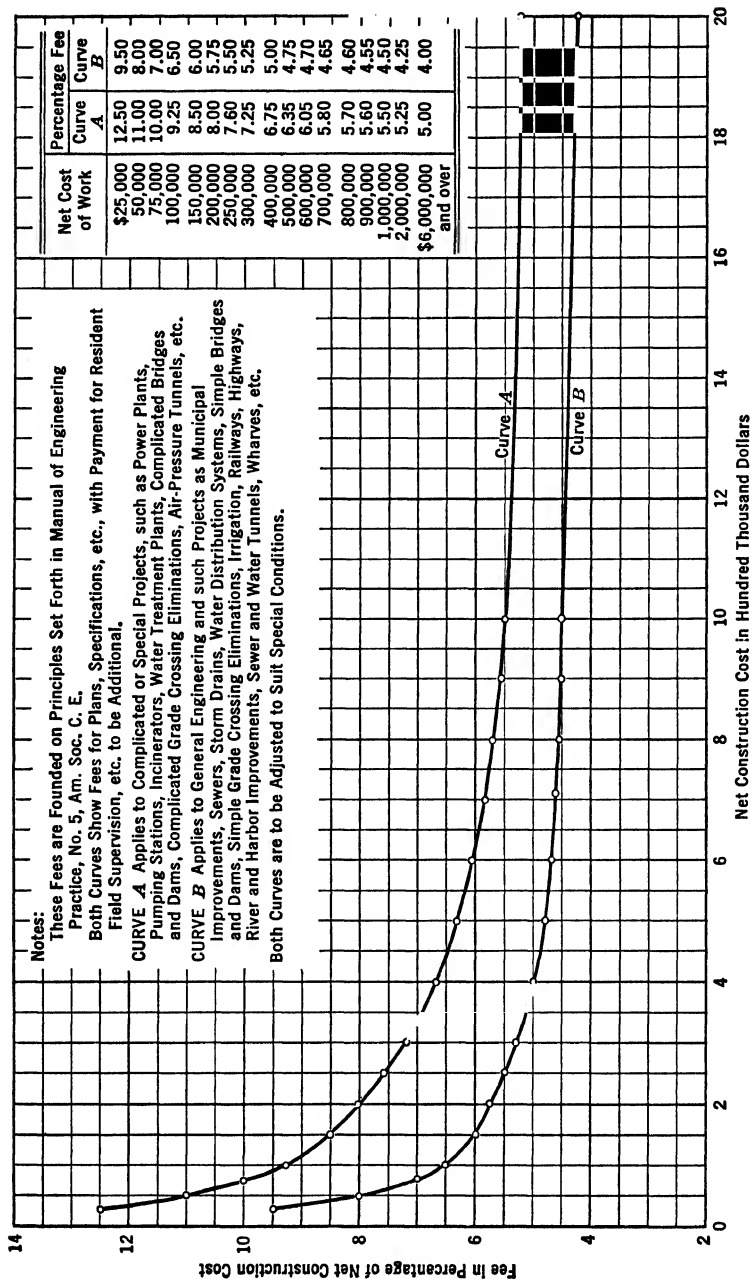
Reviewing estimates for progress and final payments to contractors.

Final inspection and report.

In addition to the fee, field surveys for preliminary investigations, field surveys for design, travel expenses, and the services of a resident engineer and field staff during construction, if required, would be paid for by reimbursement of actual out-of-pocket expenses plus 25 to 100 per cent for overhead and profit, depending on the character of the work. An alternate arrangement provides for an increase in the fee in the amount of about  $1\frac{1}{2}$  to 2 per cent of the construction cost to cover general field engineering and supervisory services during construction in lieu of the direct reimbursement of expenses on a true cost-plus-overhead basis.

Provision should also be made for additional compensation to cover such extra services as alternate designs, redesign after the original drawings have been accepted, consultants' fees when specialized services are required over and above those normally expected of the engineer, and testimony in court or arbitration proceedings connected with the work. Mention should also be made that the client is responsible for the costs of all inspections and tests either in the mill, shop, or field. The cost of tests is sometimes covered by arranging for the construction contractor to include such expenses in his bid.

Progress or interim payments on account of the engineer's fee are made at stated intervals. The amounts of such payments may be determined on the basis of the net cost expended, the percentage of the engineering work physically completed, or stipulated percentages of the total fee at various stages of the work.



RECOMMENDED FEES FOR PROFESSIONAL ENGINEERING SERVICES FOR FEDERAL AND FEDERAL AID PROJECTS.

*EXAMPLES OF CONTRACTS FOR ENGINEERING AND  
ARCHITECTURAL SERVICES*

**TYPICAL LETTER "OFFER AND ACCEPTANCE"  
CONTRACT**

Mr. \_\_\_\_\_, Chief Engineer

Department of Highways

State of \_\_\_\_\_

Dear Sir:

We are pleased to submit herewith our proposal for designing the proposed bridge over the \_\_\_\_\_ River at \_\_\_\_\_

Our services would include the following items:

1. Assisting your department in the determination of the final location of the main span and approaches on the basis of economic and engineering considerations.

2. Specifications for, and supervising the taking of borings. The cost of making the borings is to be borne by the State.

3. Preliminary designs, including general drawings, basic specifications and estimates of cost, for your consideration and approval. This item will include studies of cantilever and suspension types of construction for the main span and will be sufficiently complete to permit your decision as to the type of structure for this crossing.

4. An architectural drawing, or rendering, of the proposed design. The primary purpose of this is to indicate the appearance of the completed structure; and secondarily to provide an acceptable picture for publication.

5. Complete final designs of the entire structure, approaches and all appurtenances. Calculations for the design will be complete, covering every section and every connection of the steel structure, including the calculation of secondary stresses where there is any possibility of their increasing the required sections. Calculations for concrete work shall be correspondingly complete. All calculations will be printed in ink on translucent paper in order that blueprints can be made.

6. Complete detail plans for the entire structure, approaches and appurtenances. Substructure drawings and drawings for the roadway slab, will show detailed working dimensions of all the concrete work and size, length, spacing and dimensions of bends of all reinforcing bars. For the steel structure, the drawings will show the sections, length and number and location of rivets for every individual piece of steel required on the structure, including the dimensions of any cuts or copes for clearances. Every drawing shall be fully checked by a man of greater experience than the one making the drawing. The drawings will be in ink on tracing cloth, and upon their completion will become the property of the State.

7. Complete technical specifications for the materials, the fabrication and the construction of the bridge. Seventy-five copies by the offset process will be furnished.

8 Calculation of quantities for the bidding schedule according to the State's usual standards

9 Checking of the shop drawings for the superstructure

10 Checking of the substructure contractor's working drawings

11 Checking of the contractor's erection methods and determination of the adequacy of falsework and cofferdams, consultation with resident and office engineers of State during construction

12 Sufficient supervision during construction of the bridge to assure the State and ourselves that the special requirements for erection are being carried out

13 Advice and supervision of a partner of the firm throughout the period that this work is in our office

We estimate that the time required for the taking of borings and preparation of preliminary designs and estimates will be about 90 days, for the substructure contract plans and specifications an additional 90 days, and for the completion of the superstructure contract plans and specifications 120 days after the completion of the substructure contract plans

We will perform all of the engineering work listed above for a fee of \$

We suggest that payments of the fee be as follows

*a* Upon completion of the supervision of the borings, a payment of \$

*b* Upon completion of the preliminary plans and estimates as given in paragraph 3, a payment of \$

\$ - may be considered to be full compensation for the services mentioned in paragraphs numbered 1 2 and 3 above if we are asked to suspend work on the design at this point

*c* Upon delivery to you of the plans and specifications for the substructure, a payment of \$

Upon delivery to you of the plans and specifications for the superstructure a payment of \$

*d* The balance should be made in payments proportional to the work done as the project proceeds

Two copies of this letter are enclosed herewith The return of one copy signed by you in the space provided will constitute your acceptance of its general intent

Yours very truly,

Consulting Engineers

Partner

By

Accepted

(Date)

, 1944

By

# **TYPICAL LUMP-SUM FEE CONTRACT FOR ENGINEERING SERVICES**

THIS AGREEMENT entered into this ..... day of ..... 194..... by ..... hereinafter called the Owner and ..... of the city of ..... in the State of ..... hereinafter called the Engineer, witnesseth that the parties hereto do mutually agree as follows:

ARTICLE I. *Services.* 1. The Engineer, for the consideration hereinafter mentioned and in the shortest reasonable time, will prepare and furnish to the Owner complete and ready for use, including such changes as may be required during the progress of the work, all necessary studies, preliminary sketches, estimates, working drawings including large scale details as required, specifications, the checking of shop drawings furnished by the construction contractor, and any consultation and advice requested by the Owner during construction and all other engineering services, including without limitation those specified hereinafter and required in connection with the accomplishment of the following project:

2. The Engineer shall, if necessary, visit the site and will hold such conferences with representatives of the Owner as may be necessary to obtain the data upon which to develop the design and preliminary sketches showing the contemplated project.

3. The preliminary sketches shall include plans, elevations and sections developed in such detail with such descriptive specifications as will clearly indicate the scope of the work, and make possible a reasonable estimate of the cost.

4. Preliminary sketches together with an estimate of the cost of the project shown on the sketches shall be submitted for the approval of the Owner.

5. The Engineer shall change the preliminary sketches for the project to the extent necessary to meet the requirements of the Owner, and after approval the Engineer shall furnish five sets of prints of the approved preliminary sketches to the Owner.

6. After the preliminary sketches and estimates have been approved, the Engineer shall proceed with the preparation of complete drawings and specifications in connection with the construction of the said project. Drawings, specifications, and estimates shall be delivered to the Owner in such sequence and at such times as will insure that the construction work can be initiated promptly, procurement of materials made without delay, and continuous prosecution of the work promoted. After drawings and specifications have been approved by the Owner, no changes therein shall



be made at the project or elsewhere, except when authorized in writing by the Owner, in which case he shall affix his approval to the drawings and specifications showing such changes.

7. Upon completion of construction work the Engineer shall deliver to the Owner six sets of blueprints showing complete approved construction requirements, as built, provided, however, that should there be unreasonable delay in the completion of construction of the project or should the construction contract be terminated before completion of the project, the Engineer shall deliver to the Owner one set of such blueprints as may be required by the Owner.

8. The Engineer shall perform all necessary engineering services of every kind required in connection with the studies, designs and the preparation of drawings and specifications, but said services shall not include borings, test piles and pits, or supervision of construction work executed from the drawings and specifications unless such additional services in whole or in part are specifically requested by the Owner or required hereby, provided, however, that the Engineer shall furnish, upon request and without additional compensation, such cooperation and conferences as may, in the opinion of the Owner, be necessary to clarify the intent of the drawings and specifications and afford the benefit of his advice on questions that may arise in connection with the construction of the project.

ARTICLE II. *Compensation.* The Engineer shall be paid as fee the lump sum of ..... (\$.....), which sum shall constitute full compensation for all services, labor and material required hereby.

Payment of the fee shall be made as follows:

[Insert schedule of progress payments.]

The fee herein stipulated to be paid shall be in full compensation for all work required of the Engineer hereunder, but the Owner will, in addition, reimburse the Engineer for: (a) The out-of-pocket expenses of travel and subsistence necessarily incurred by the Engineer or his representative, in performance of this contract, other than for visits to the site required in performance of the services to be rendered. All authorizations for travel must be applied for in writing and approved prior to actual travel, unless approved by the Owner subsequent to actual travel pursuant to a finding by the Owner that emergent circumstances rendered impracticable such prior application and authorization; and (b) all direct out-of-pocket expenses, inclusive of overhead, incurred by the Engineer in connection with obtaining field and laboratory data or any special services, when such is authorized by the Owner to be furnished in assisting in the work of construction, as distinct from the engineering work required by this contract.

ARTICLE III. *Changes.* 1. If, after the preliminary drawings have been approved and the Engineer has been authorized to proceed with the preparation of working drawings and has performed work on the drawings pursuant to these instructions, a radical change in the plans or designs of the project is determined upon, requiring new sketches and working drawings and specifications, or revisions or modifications of the existing drawings and specifications, then the Engineer shall be paid additional compensation in an equitable amount to be agreed upon between the Engineer and the Owner.

2. The Engineer shall make, whenever required to do so by the Owner, such revisions and alterations in the working drawings and specifications of the project as may be necessary to insure the proper construction and completion thereof within the established limit of cost.

3. Should the scope of the project be increased for any reason there shall not be paid to the Engineer any additional compensation unless such increase in the scope of the project involves the preparation of additional drawings and specifications, in which case just and equitable additional compensation shall be paid to the Engineer, as may be agreed upon between the Engineer and the Owner, or should the scope of the project be decreased whereby the services required hereunder are decreased, the fee allowed hereby will be reduced in such amount as may be agreed upon between the Engineer and the Owner.

ARTICLE IV. *Termination of Contract.* If the Owner shall at any time during the performance of this contract deem it inexpedient to have the construction work executed as shown by the drawings, plans and specifications prepared and submitted by the Engineer, but shall require the omission of construction work as originally contemplated or its execution in accordance with other drawings, plans and specifications, or the Owner shall deem it expedient, or it shall become necessary on behalf of the Owner, to abandon or indefinitely defer the construction work or any part thereof, contemplated under this contract, or for any reason the Owner shall decide to terminate performance by the Engineer of the services to be rendered under this contract, before completion of the services to be rendered hereunder, upon any such action being taken by the Owner, the Engineer's fee shall be subject to an equitable adjustment as agreed upon between the Engineer and the Owner.

ARTICLE V. *Transfer of Contract and Assignment of Engineer's Claims.* Neither this contract, nor any interest herein, nor any claim arising hereunder shall be transferred or assigned by the Engineer to any other party or parties.

ARTICLE VI. *Patents.* The Engineer shall hold and save the Owner, his officers, agents, servants, and employees, harmless from patent liability of any nature or kind, including costs and expenses, for or on account of any patented or unpatented invention made or used in the performance of this contract, including the use or disposal thereof by or on behalf of the Owner. *Provided,* That this Article is not, and shall not be construed to be, applicable to any infringement of United States Letters Patent which results from the Engineer complying with specific written instructions furnished by the Owner, or where infringement is occasioned by the use of an apparatus patent due to the fabrication, installation, or operation of apparatus in accordance with plans and specifications furnished to the Engineer by the Owner.

ARTICLE VII. *Arbitration.* All questions, disputes and differences arising between the Owner and the Engineer shall, upon written request by either party, be submitted to arbitration by three arbitrators, one to be appointed by each of the two parties and a third by common accord between the two thus appointed. If either party shall, within fifteen (15) days after the written request for arbitration, refuse to submit to arbitration or shall have failed to appoint an arbitrator, the President of the American Arbitration Association then in office shall appoint an arbitrator for such party. If the two arbitrators so appointed shall fail to appoint a third arbitrator within ten (10) days after the appointment of the second arbi-

trator, the President of the American Arbitration Association then in office shall appoint a third member. The Owner and the Engineer hereby agree to be bound by any decision of such arbitrators.

IN WITNESS WHEREOF, the parties hereto have executed this contract as of the day and year first above written.

### **Cost-Plus-a-Fixed-Fee Contracts for Professional Services.**

The contract may be an offer and acceptance by letter of the type reproduced on page 227, or it may be a formal document similar to the example on page 229 which is drawn on a lump-sum-fee basis. The latter would require only minor modification in Article II to adapt it to the basis of a fee which is a specified percentage of the actual construction cost. To adapt this contract to a cost-plus-a-fixed-fee basis, however, the following should be inserted in lieu of Article II.

ARTICLE II. *Compensation.* 1. The Engineer shall be paid as full compensation for all services rendered hereunder the sum of the amounts stated in subsections (a) and (b) of this paragraph.

(a) The Engineer shall be reimbursed in an amount equal to the sum of the cost actually incurred and directly chargeable to the services to be rendered hereunder, for labor, materials and other expenses,

Provided, however, that the necessity for the incurrence of any of such expenses and the amounts thereof shall in each instance be subject to the approval of the Owner.

(b) In addition to the payments to be made as set forth in (a) above, the Engineer shall be paid as fee the fixed sum of .....

(\$.....), which reimbursable payments and fee shall constitute complete compensation for the Engineer's Services, including the services of partners or corporate officers, and all overhead expenses except as otherwise herein expressly provided.

2. The payments heretofore stipulated to be made shall be in full compensation for all work required of the Engineer hereunder, except that the owner will, in addition, reimburse the Engineer for: (a) The out-of-pocket expenses of travel and subsistence necessarily incurred by the Engineer or his representatives in performance of this contract, other than for visits to the site, required in performance of the services to be rendered. All authorizations for travel must be applied for in writing and approved prior to actual travel, unless approved by the Owner subsequent to actual travel pursuant to a finding by the Owner that emergent circumstances rendered

impracticable such prior application and authorization, and (b) all direct out-of-pocket expenses, exclusive of overhead, incurred by the Engineer in connection with obtaining field and/or laboratory data or any special services when such is authorized to be obtained by the Owner to be furnished in assisting in the work of construction as distinct from the engineering services required by this contract.

3. At intervals to be agreed upon between the Engineer and the Owner during the progress of the work, the Engineer shall prepare a statement of the payments actually made for items reimbursable under the provisions of this contract during the preceding period for which reimbursement has not been made, and including, if desired by the Engineer, an estimate of the portion of the Engineer's fixed fee earned. Such statements with original certified payroll, receipted bills for all reimbursable expenses, and other supporting data as may be required, shall be delivered to the Owner. The approved amounts of such statements shall be the basis for progress payments to the Engineer.

4. Payments of reimbursable cost items and of the amount of the Engineer's fee earned shall be made as soon as practicable after the submission of statements and supporting data required by paragraph 3 above. Upon completion of the project and its final acceptance the Engineer shall be paid the unpaid balance of any money due the Engineer hereunder. Prior to final payment under the contract, or prior to settlement upon termination of the contract, and as a condition precedent thereto, the Engineer shall execute and deliver to the Owner a release of claims or demands of any nature whatsoever, against the Owner arising under or by virtue of this contract.

5. (a) The Engineer shall keep records and books of account showing the cost of performing this contract. The method of accounting employed by the Engineer shall be subject to the approval of the Owner but no material change will be made in the Engineer's method of accounting if it conforms to good accounting practice.

(b) The Owner or his authorized representative shall at all reasonable times have access to all records and books of account pertaining to this contract. All information obtained from said records and books of account shall be treated as confidential.

### **U.S. Government Contracts for Professional Services.**

Service contracts between the United States and professional engineers or architects follow private practice more closely than do construction contracts. Inasmuch as engineering and architectural agreements are almost always negotiated, legal restrictions relative to bidding and awarding of contracts are not involved. However, the requirements in connection with disputes and the settlement of claims are the same as for construction contracts. Lump-sum and fixed fees are limited, usually to 6 or 7 per cent of the estimated construction cost of the work. This limitation usually is imposed by the Congressional Appropriation Act which provides the funds for the work and its amount is variable, depending upon the wording of the act.

In private practice, tracings, drawings, and other permanent records in connection with the design are owned by the engineer and may not be used again without his permission whereas U.S. Government service contracts always stipulate that such drawings are to become the property of the government.

**Some Precautions in the Preparation of Engineering and Architectural Contracts.** Of utmost importance in the drawing of contracts for professional services is the definition of the scope of the services to be furnished. The statement should be definite and should establish the limits of the engineer's responsibilities beyond question. To be avoided are such general statements as, "The engineer shall do all engineering work and perform all engineering services required in connection with the construction of the project." Such a requirement may obligate the engineer, at his own expense, to represent the client in lengthy and costly investigations and court procedure if litigation should develop from the work. This may be true even though the dispute might have no direct connection with the plans and specifications. The contract should be specific in providing for additional compensation for any services required other than those contemplated by the agreement and on which the original fee was based.

The method of calculating the fee should be set forth clearly. This question usually will not arise on lump-sum contracts, but when the fee is based on a percentage of the construction cost the contract should describe the construction work to be included. Unless this is done, controversies are likely to occur in connection with the right of the engineer to collect a fee on the purchase of equipment not designed by him and other work incidental to the project but not specifically included in the construction contract. Typical of the latter class is landscaping, the furnishing and decorating of buildings, the purchase of turbines for power plants, and motors for movable bridges. Usually such items are closely related to the planning of the project, and the engineer's advisory services, if not actual drawings, are required. Therefore, it is generally considered that he is entitled to a fee based on the total cost of all the work, whether it is all designed in detail or not, it being understood that professional advice in connection with the procurement of appurtenances is not to be

distinguished from detailed design as far as the calculation of the fee is concerned.

Occasionally an engineer will undertake work on which he will be obliged to accept stock in the project as partial compensation for his services. Such a situation implies many dangers to the engineer, and he should enter into an agreement of this type only after careful consideration and after obtaining legal advice. For instance the ownership of some kinds of stock may make the owner liable for financial obligations of the company or corporation which issued it. There is also the matter of the par value of the stock as compared with the value at which the engineer accepted it. This may have important implications with regard to the assessment of taxes.

Particular attention should be given to provisions for the determination of the engineer's fee when the project is cancelled and the contract terminated before the completion of the work. This is especially true when the fee is to be based on a percentage of the construction cost. If the contract is not specific in this respect, the engineer may find himself unable to collect payment for the preparation of plans and specifications, for instance, if the project should be abandoned after the completion of the design but before the beginning or in the early stages of construction.

It should be noted that unless the contract provides otherwise the ownership of plans and specifications is vested in the client. In private work it is standard practice for the engineer to retain ownership of these documents, and the contract should make this provision. As previously mentioned U.S. Government practice is contrary to private practice in this regard.

Under ordinary engineering and architectural contracts it is understood that the cost of field surveys, foundation explorations, materials testing, and similar expenses is to be borne by the client and is not included in the fee. Travel and subsistence expenses of the engineer and his representatives when away from his main office in connection with the work are sometimes included in this category. If the contract does not place the responsibility for such costs on the client the engineer may find himself liable for their full amount. The standard bases for the determination of fees do not anticipate such expenses and such a condition would normally result in a large loss to the engineer. If it

is intended that the engineer should furnish these services, proper allowances should be made in arriving at the amount of the fee, and they should be mentioned specifically in the contract as being within the scope of the work.

The engineer should pay special attention to the wording of the terms of the contract in connection with estimates of construction costs to avoid any possibility of allowing himself to become liable for their accuracy. If this is not done it may be construed that the estimate is a guarantee of a limit of cost, in which case the engineer could be held responsible for any difference between the estimate and the actual cost of the work. Such a condition is, of course, never intended in view of the constantly fluctuating wage rates and materials costs and considering the fact that engineer's estimates are usually made well in advance of actual construction.

The engineer's rights and responsibilities as the agent of his client should be definitely stated. Under the ordinary contract the agency exists whether stated expressly or implied. Therefore it is recommended that the terms be definite in order that both parties may understand clearly the basis of the agreement. This is advisable particularly with respect to the engineer's authority to make changes in the plans during the progress of the work, to issue change orders to the construction contract, to receive bids and award contracts, to approve the contractor's shop drawings, and other similar functions required on all construction work. Otherwise the engineer may find himself financially liable for the cost of changes or the cost of mistakes discovered in contractor's shop drawings after they have been approved in general by the engineer. In the latter connection the engineer's approval of shop drawings should never imply responsibility for their accuracy afterwards. When the engineer receives bids and awards contracts or approves subcontracts he should always state expressly that this is being done in the name of his client, otherwise he may be held liable if the client should default or breach the contract. In this connection reference is made to the laws relative to the responsibilities of an agent acting for an undisclosed principal. If it is intended that the engineer shall not be authorized to act as an agent of the client in these matters the contract should state that the engineer is acting as an independent contractor rather than as an agent. Under this condition the engineer should refuse to take any direct action in connection with the

work, unless he is expressly authorized to do so. All his recommendations should be made to the client who should be required to authorize, in writing, any necessary orders or approvals to the engineer or to the construction contractors.

### Questions

1. List the work to be included in a contract for complete engineering or architectural services in connection with a construction project beginning with preliminary surveys and extending to the preparation of "as-built" drawings.

2. What are the essential terms of a contract for engineering or architectural services?

3. Why is it advisable to establish a time limit beyond which an engineer would not be obligated under the contract?

4. Explain the importance of a definite description of the scope of the work under a contract for engineering or architectural services.

5. What provisions should be made for the determination of the engineer's fee when work under the contract is terminated before completion?

6. Why should change orders on construction work always be signed by the owner although they may have been initiated by the engineer?

7. Compare the letter "offer and acceptance" contract with the formal type with respect to (a) legality, (b) relations with the client, and (c) adequacy.

8. What are the relative advantages and disadvantages of the lump-sum-fee type of contract for engineering or architectural services as compared with a fee based on a percentage of the actual cost of construction?

9. Can engineering and architectural plans and specifications be copyrighted?

10. Who owns the plans and specifications at the end of the job if the contract is not specific in this regard?

11. Under what conditions could the engineer or architect become obligated to pay the costs of borings and tests required in connection with a construction project?

12. What precautions should be observed by an engineer or an architect in accepting stock in a completed construction project as total or partial payment of his fee?



# IO

## ELEMENTS OF THE SPECIFICATIONS

The specifications are written instructions which supplement the drawings to formulate the technical requirements of the work. Also they define the quality of materials and workmanship desired by the owner and serve as a standard and guide for the contractor. In general, the drawings show *what* is to be done whereas the specifications state *how* it is to be accomplished. The specifications are usually given greater legal strength than the drawings, and most contracts state that in case of a conflict between the two the provisions of the specifications shall govern. Both the drawings and specifications are integral parts of the contract documents and allocation of subject matter between the two is largely a matter of expediency. Those requirements, such as arrangement, dimensions, and types of construction which are more readily expressed graphically, are shown on the drawings while instructions that can be more clearly expressed when written are placed in the specifications. It is understood that the combination of the drawings and specifications will define completely the physical, technical, and operating characteristics of the finished project.

Specifications are of necessity comprehensive and deal with many kinds of materials and many types of construction. Therefore, the composition should be logical and systematic; otherwise there may be repetitions, omissions, and conflicting statements which lead to confusion and disputes during construction.

The clauses of the specifications will be of two classifications.

- a. The *general provisions* which apply to the work as a whole.
- b. The *technical provisions* which describe the technical details of each type of construction.

In composition the specifications are usually written in sections, the first of which consists of the general provisions. This is

followed by the technical provisions using a separate section for each type of construction.\*

**The General Provisions.** The general provisions of the specifications cover such topics as the description of the work, reference to the contract drawings, work or materials to be furnished by the owner or by other contractors, work or materials to be covered by standard specifications to be found elsewhere, shop drawings, control of materials, and the like. These are usually technical in nature and apply to the project as a whole; but non-technical provisions not covered in the other contract documents may also be included. The general provisions are similar in character to the general conditions of the contract and allocation of subject matter between these two documents in many instances is a matter of preference and emphasis. Although the provisions of the contract and the specifications are equally binding, the contract is the stronger document legally, and its articles undoubtedly receive greater emphasis. Frequently the owners' legal department will desire to use a standard form of contract, and this will have an important bearing on the contents of the general provisions of the specifications.

Typical clauses of the general provisions are outlined in detail in Chapter 12.

**The Technical Provisions.** The technical specifications contain the detailed instructions necessary to obtain the desired quality and service in the finished product. In addition to the technical requirements it also is necessary to provide for inspection and tests during construction to make certain that the specified requirements are being obtained.

The writing of the technical specifications must be coordinated closely with the preparation of the drawings. As the design progresses it will be desirable to prepare an outline of the items of work to be covered, and the writing of the technical provisions can proceed concurrently with the completion of the drawings. In making up the outline the entire work must be analyzed carefully and all items and processes noted.

One section of the specifications should be devoted to each type of construction, such as earthwork, concrete, masonry, carpentry,

\*In an alternative method of composition the specifications are divided into Part I, General Provisions, and Part II, Technical Provisions, the sections of each part being numbered independently.

and structural steel. Equipment and machinery will be covered likewise either in an individual section for each item or with groups of related items collected in one section. Similarly, it may be convenient to devote separate sections to each of the basic materials which are used in several types of construction. This will reduce repetition and the number of cross references otherwise required. For example, Portland cement may be used in concrete, masonry mortar, plaster, stucco, and cement grout, and one section in the technical provisions may be made to cover its use in each of those types of construction. There is no fixed rule for the order in which the various types of construction should appear in the specifications, but, in general, they should follow as closely as practicable the sequence of construction operations.

Typical clauses of the technical provisions for various structures are outlined in Chapter 12.

**The Use of Standard Specifications.** Specifications are seldom written in total for any particular project. Like the other contract documents certain parts are capable of standardization for use on all work of a given type, and practically all engineering offices develop their own standard clauses. Some engineers find it convenient and efficient to catalog such clauses in a card index file or to prepare them in skeleton form with blank spaces provided for the insertion of variable requirements. In preparing specifications for a particular job the standard clauses are combined with those written especially for the work, and the complete assembly makes up the specifications.

The development of office standards is a continuous process in which it is necessary for the engineer to keep abreast of standard practice and improvements in construction materials and processes. Careful notes and records should be made during the construction of one job in order that revisions, corrections, and improvements may be made in the specifications for the next job. The repeated use of specification clauses from job to job by the so-called "scissors and paste pot" method is a notorious cause of difficulties during construction. No specification clause from a previous job should ever be used until a careful review has indicated its suitability.

Standardization of specifications for construction materials and processes has been the subject of much study and research by the

various professional societies, government agencies, and manufacturers' associations. The recommendations of these organizations form the basis of current construction practice, particularly with regard to quality of materials. Any standard specification may be incorporated into a contract by reference, and this procedure is universally followed for construction work. Most of the common standards are so widely distributed as to be readily available to everyone in the construction industry. The following is a representative list of sponsors of standard specifications for various materials and types of construction.

PROFESSIONAL ENGINEERING SOCIETIES.

American Society for Testing Material.

American Railway Engineering Association.

American Society of Mechanical Engineers.

American Concrete Institute.

American Association of State Highway Officials.

Society of Automotive Engineers.

GOVERNMENT AGENCIES,

Federal Specifications.

Various Department and Bureau Specifications.

Various State Highway Department Specifications.

MANUFACTURERS' ASSOCIATIONS.

American Institute of Steel Construction.

Portland Cement Association.

National Lime Association.

Various Lumber Associations.

The most widely used of all standard specifications are probably those of the American Society for Testing Materials and the federal government. The A.S.T.M. specifications are published individually and may be purchased from the American Society for Testing Materials, Philadelphia, Pa. They are also collected in book form under the following titles.

A.S.T.M. Standards:

*Part I, Metals;*

*Part II, Non-Metallic Materials, Constructional;*

*Part III, Non-Metallic Materials, General.*

Federal government specifications are prepared by committees representing the various government agencies and bureaus and

may be obtained from the Government Printing Office, Washington, D. C.

Most individual standard specifications are given serial designations and are revised from time to time to reflect developments and improvements in techniques and processes. When a standard specification is to be incorporated into a specific contract by reference, care must be taken to make certain that the proper edition is designated. The reference should always include the title, serial designation, date of issue, and name of sponsoring organization. Any desired changes or modifications in the standard specification should be covered in detail.

In addition to the organizations listed herein, many individual manufacturers maintain research staffs which prepare specifications for their particular products and make them available to specification writers. Although such specifications may be biased and written with the view of promoting sales, they usually represent the best current practice when prepared by reputable firms. The products covered are usually patented or otherwise proprietary, and care should be taken to see that competitive products are not eliminated by the wording of the specifications.

Specification clauses are sometimes prescribed by law. All major cities have building codes and safety codes designed to enforce construction methods which will be safe for the probable loadings and occupancy and which will result in structures resistant to fire, wind, and other hazards. Many states have similar codes which are also enforced. Specification clauses must conform to such codes. Likewise, the recommendations and specifications of the National Board of Fire Underwriters must be followed closely to avoid excessive insurance rates. Also specification clauses may be influenced by local court decisions in previous lawsuits. Legal interpretations of ordinances and laws may vary from state to state or even from city to city, and the specification writer must have some familiarity with local precedents in this respect. Within their jurisdiction all of these requirements assume the aspects of standard specifications.

When appropriate, the use of standard specifications has many advantages. Standardization of products and production methods is encouraged, resulting in reductions in manufacturing costs and, therefore, in lower costs to the consumer. Constant improvements in products may be expected through cooperative research.

Field control is simplified through the use of standard methods of inspection and tests. On the other hand, it should be kept in mind that standard specifications are written for average conditions and frequently require supplemental clauses to fit them for a particular purpose. Furthermore, special features of a particular project may make them entirely unsuitable. Such possibilities emphasize the necessity for a complete understanding of standard specifications before they are adopted for contract purposes.

**Types of Technical Specifications.** The form of the technical provisions will depend to a considerable extent on the methods of inspection and testing to be applied during construction. A comprehensive project, such as a building or bridge, is made up of a large number of parts, and no practicable test or series of tests is available to prove that the finished structure will perform its required service throughout the desired period of time. It becomes necessary therefore to control the quality of materials and workmanship in the manufacture, fabrication, and assembly of the various parts and to rely on the sufficiency of the design to obtain satisfactory performance in the finished structure. Accordingly, specifications for materials and workmanship are used for most of the basic types of construction. In this type of specification responsibility is placed upon the contractor for furnishing materials and workmanship conforming to the requirements specified for each type of construction and for the assembling of the component parts of the structure, but if these are free from defects the responsibility for the over-all performance of the assembled structure rests upon the owner inasmuch as he furnished the plans and specifications. An exception exists when the contract requires the contractor to guarantee the sufficiency of the plans in which case he becomes responsible for performance also. This requirement was once widely used but now it is seldom encountered.

A second type of specification is based on the over-all performance of the finished product. When the desired operating characteristics can be measured by tests this form of technical specification is indicated. Specifications based on performance are frequently used for equipment and machinery, such as pumps, motors, and other accessories. Performance tests, however, are not necessarily indicative of the life of the structure, and it is

customary to require the contractor to furnish warranties to guarantee durability and the absence of defects in materials and workmanship.

A third type of specification frequently used for construction work is based on the selection of proprietary or "standard brand" products in the open market. These may be either items of materials or equipment to be used separately or in connection with other processes or components of the work. No control can be exerted over the manufacture of proprietary articles, and the specifications may merely identify a desired item known to be satisfactory for the purpose intended, or quality and performance tests or standards may be prescribed. In either event careful wording of the specification is necessary because of the legal and competitive aspects of the procurement of patented commodities.

**Specifications for Materials and Workmanship.** The selection of materials for specific purposes in construction is a matter of design and economy and requires expert knowledge of the technology of materials. In general, the selection will be made on the basis of the critical properties of the material and its cost as compared with available alternatives. Frequently appearance is also a consideration. A wide variety of materials is available for construction work, and each has many characteristics. Most of these materials are suitable for more than one purpose, and two or more materials may be suitable for the same purpose. Therefore, the specification writer is faced with the problem of obtaining those properties necessary for the particular purpose at hand and of limiting or prohibiting those considered unsuitable or detrimental. Those properties which have little or no bearing should not be mentioned. Specifications for some materials will be based on physical or chemical properties, and for others performance will be the desirable method. Frequently a combination of the two types will be desirable. In general, proprietary or patented materials should not be specified by brand name, but the specifications should be so worded as to permit their use if the composition and performance requirements are fulfilled and if they are otherwise acceptable.

In so far as practicable the properties specified should be capable of measurement and proof by tests. The testing of materials is a well-developed science, and only standard tests should be specified. Some properties of materials, such as appearance, tex-

ture, and the like, cannot be measured and tested, and their approval and acceptance must be left to the judgment of the engineer during construction. Samples should be required for this purpose before the materials are purchased. An experienced engineer can determine the quality of many other properties by inspection and in these instances tests may be omitted.

The principal properties to be considered in the preparation of specifications for materials in construction work are as follows.

*a.* Physical properties, such as strength, modulus of elasticity, durability, hardness, ductility, and the like.

*b.* Chemical composition.

*c.* Electrical, thermal, and acoustical properties, such as conductivity and resistance.

*d.* Appearance, including color, texture, and pattern.

*e.* Transportation, handling, and storage. Some materials are subject to deterioration or breakage under certain conditions, and the specifications should cover the protection necessary in the interval between the manufacture or processing of the materials and their incorporation into the structure.

*f.* Inspection, tests, and analyses, which are the methods for the control of the manufacture or processing of the materials and the grade or quality of the finished product. The specifications should state whether inspection is to be at the shop, mill, or in the field.

The first principle in writing specifications for workmanship is that, in so far as practicable, results only should be specified, allowing the contractor maximum latitude as to the selection of construction methods. Exceptions to this rule are justifiable and permissible, however, in the case of certain types of construction in which it is necessary to designate methods and procedures in order to insure the satisfactory completion of the work. For example, it is customary to specify the method for compacting earth fill used in the construction of embankments, earth dams, and such structures. Precautions, restrictions, and limitations may also be imposed on construction methods for the purpose of protection and coordination of the work as a whole without affecting the independent contractor relationship. This also applies to the question of the order of construction operations when a definite sequence is made necessary by design conditions or to meet condi-



tions contemplated by the owner. It should be noted, however, that such restrictions and limitations have a direct influence on the cost of the work and may not be imposed on the contractor after the bid is submitted without a change in the bid amount.

The writing of specifications for construction and workmanship requires expert knowledge of construction methods and the standards of workmanship attainable. The usual procedure is along the following lines.

*a.* Specify the results desired as to quality of workmanship and finish, giving due consideration to practical limitations in tolerances, clearances, and the like.

*b.* State any detailed construction methods or procedures necessary for the accomplishment of particular purposes.

*c.* Stipulate any desired limitations or restrictions to be placed on the contractor's methods in the interests of the coordination of the work.

*d.* Give any precautions necessary for the protection of the work or adjacent property.

*e.* Specify the methods of inspection and tests to which the work is to be subjected with particulars as to mill and shop inspection as well as field inspection.

#### *EXAMPLE OF SPECIFICATIONS FOR MATERIALS AND WORKMANSHIP*

### **STEEL ARCH BRIDGE \***

#### **SECTION 6. STRUCTURAL METAL WORK**

##### **MATERIALS**

6.01. *Structural Steel.* All structural carbon steel, bolts, and steel billets shall conform to the requirements of the Standard Specifications for Structural Steel for Bridges of the American Society for Testing Materials, Serial Designation A7-36, and all silicon steel to the requirements of the Standard Specifications for Structural Silicon Steel of the same Society, Serial Designation A94-36, supplemented by the following paragraphs:

Test specimens of structural steel shall show a fracture having a silky or fine granular structure throughout with a bluish gray or dove color, and shall be entirely free from granular, black and brilliant specks.

Finished rolled material shall be free from cracks, flaws, injurious seams, laps, blisters, ragged and imperfect edges, and other defects. It

\* Adapted from the specifications for the Rainbow Bridge, Niagara Falls; Waddell and Hardesty, Consulting Engineers.

shall have a smooth, uniform finish, and shall be straightened in the mill before shipment.

Material shall be free from loose mill scale, rust, pits, or other defects affecting its strength and durability.

Physical tests shall be required for billets bearing against, or functioning as, expansion rollers or rockers.

Rivet steel shall conform to the requirements of the Standard Specifications for Structural Rivet Steel of the American Society for Testing Materials, Serial Designation A141-38.

**6.02. Steel Castings.** Steel castings shall conform to the requirements of the Tentative Specifications for Carbon Steel Castings for Miscellaneous Industrial Uses of the American Society for Testing Materials, Serial Designation A27-36T, with the following additions:

Unless otherwise specified, all steel castings shall be Grade B-1, full-annealed.

Test specimens shall show a fracture having a silky or fine granular structure throughout.

Blow holes appearing upon finished castings shall be so located that a straight line laid in any direction will not cut a total length of cavity greater than one inch in any one foot, nor shall any single blow hole exceed one inch in any dimension or have an area greater than one-half square inch. Blow holes shall not have a depth injuriously affecting the strength of the casting.

Large castings, if required by the Engineers, shall be suspended and hammered all over. No cracks, flaws or other defects shall appear after such treatment.

No sharp unfileted angles or corners will be allowed.

One tension test and one bend test shall be made from each melt in each heat treatment charge and from each casting weighing 500 pounds or over.

**6.03. Iron Castings.** Iron castings shall conform to the requirements of the Standard Specifications for Gray Iron Castings of the American Society for Testing Materials, Serial Designation A48-36, Grade 30, with the following additions:

Iron castings shall be true to pattern in form and dimensions, and free from pouring faults, sponginess, cracks, blow holes and other defects in positions affecting their strength and value for the service intended.

Castings shall be boldly filleted at angles and the arrises shall be sharp and perfect.

Castings having blow holes plugged or filled with putty or cement of any kind will be rejected.

**6.04. Steel Forgings.** All carbon and alloy steel forgings from which pins, rollers, and other forged parts are to be made shall conform to the requirements of the Standard Specifications for Carbon-Steel and Alloy-Steel Forgings of the American Society for Testing Materials, Serial Designation A18-30, with the following additions:

Structural forgings shall be Class C carbon steel, unless otherwise called for. All forgings shall be thoroughly annealed.

The yield point of Class C forgings shall be not less than 33,000 pounds per square inch.

The tensile requirements for forgings from 20 to 30 inches in diameter shall conform to the requirements for forgings 12 to 20 inches in diameter.

A Class C carbon steel specimen  $\frac{1}{2}$  inch by  $\frac{1}{2}$  inch in section shall bend cold 180 degrees around a diameter of  $\frac{1}{2}$  inch, without cracking on the outside of the bend. The bending may be effected by pressure or by blows.

6.05. *Wrought Iron.* Wrought-iron plates shall meet the requirements of the Tentative Specifications for Wrought-Iron Plates of the American Society for Testing Materials, Serial Designation A42-37T.

Wrought-iron shapes and bars shall meet the requirements of the Tentative Specifications for Rolled Wrought-Iron Shapes and Bars of the American Society for Testing Materials, Serial Designation A207-38T.

Terms relating to wrought iron are to be as defined in the Standard Definitions of Terms relating to Wrought-Iron Specifications of the American Society for Testing Materials, Serial Designation A81-33.

6.06. *Wrought-Iron Pipe.* Wrought-iron pipe shall conform to the requirements of the Standard Specifications for Welded Wrought-Iron Pipe of the American Society for Testing Materials, Serial Designation A72-38. All wrought-iron pipe shall be marked in raised letters with trade name or manufacturer's name.

6.07. *Steel Pipe.* All steel pipe shall be copper-bearing welded steel pipe conforming to the requirements of the Standard Specifications for Welded and Seamless Steel Pipe of the American Society for Testing Materials, Serial Designation A53-36.

6.08. *Malleable Castings.* Malleable castings shall conform to the requirements of the Standard Specifications for Malleable Castings of the American Society for Testing Materials, Serial Designation A47-33.

Malleable castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes and other defects in positions affecting their strength and value for the service intended.

The castings shall be boldly filleted at angles, and the arrises shall be sharp and perfect. The surface shall have a workmanlike finish.

Particular care shall be exercised so as not to embrittle malleable castings when galvanizing. All galvanized malleable castings shall meet specification requirements after galvanizing.

6.09. *Rolled Phosphor-Bronze.* Rolled Phosphor-Bronze shall conform to the requirements of the Tentative Specifications for Rolled Copper-Alloy Bearing and Expansion Plates for Bridge and Other Structural Uses of the American Society for Testing Materials, Serial Designation B100-38T.

## FABRICATION

6.10. *Storage of Materials.* Structural material shall be stored above the surface of the ground upon platforms, skids, or other supports, and shall be protected as far as practicable from surface deterioration by exposure to conditions producing rust. It shall be kept free from accumulations of dirt, oil or other foreign matter.

6.11. *Straightening Material.* All deformed structural material shall be properly straightened by methods which are non-injurious prior to being

laid off, punched or otherwise worked in the shop. Sharp kinks and bends shall be cause for rejection.

6.12. *Workmanship and Finish.* The workmanship and finish shall be first class and equal to the best practice in modern bridge shops. Shearing and chipping shall be neatly and accurately done, and all portions of the work exposed to view shall be neatly finished.

6.13. *Rivet Holes.* When reaming is not required, holes in material  $\frac{3}{4}$  inch or less in thickness may be punched full size. Holes in material more than  $\frac{3}{4}$  inch in thickness shall be sub-punched and reamed, or drilled from the solid.

Holes in carbon steel more than  $\frac{7}{8}$  inch thick, or in silicon steel more than  $\frac{3}{4}$  inch thick, shall be drilled.

6.14. *Punched Holes.* Full size punched holes shall be  $\frac{1}{16}$  inch larger than the nominal diameter of the rivet. The diameter of the die shall not exceed the diameter of the punch by more than  $\frac{3}{32}$  inch. Holes must be clean cut, without torn or ragged edges. If any holes must be enlarged to admit the rivets, they shall be reamed.

6.15. *Accuracy of Punched Holes.* The punching of holes shall be so accurately done that, after assembling the component parts of a member, a cylindrical pin  $\frac{1}{8}$  inch smaller than the nominal diameter of the punched hole may be passed through at least 75 of any group of 100 contiguous holes in the same surface or in like proportion for any group of holes. If this requirement is not fulfilled, the badly punched pieces shall be rejected. If any holes will not pass a pin  $\frac{3}{16}$  inch smaller than the nominal diameter of the punched hole, this shall be cause for rejection.

6.16. *Drilled Holes.* Drilled holes shall be  $\frac{1}{16}$  inch larger than the nominal diameter of the rivet. Burrs on the outside surfaces shall be removed with a tool producing a  $\frac{1}{16}$ -inch fillet around the edge of the hole.

6.17. *Sub-Punched and Reamed Holes.* Sub-punched and reamed holes for rivets having diameters greater than  $\frac{3}{4}$  inch shall be punched  $\frac{3}{16}$  inch smaller than the nominal diameter of the rivet, and for rivets having diameters  $\frac{3}{4}$  inch or less the holes shall be punched  $\frac{1}{16}$  inch less than the nominal diameter of the rivet. The punch and die shall have the same relative sizes as specified for full-size punched holes. After punching, the holes shall be reamed to a diameter  $\frac{1}{16}$  inch larger than the nominal diameter of the rivet. Burrs resulting from reaming shall be removed with a tool producing a  $\frac{1}{16}$ -inch fillet around the edge of the hole.

Reaming of rivet holes shall be done with twist drills or with short taper reamers. Reamers shall not be directed by hand. No oil or grease shall be used as a lubricant.

6.18. *Accuracy of Reamed and Drilled Holes.* Reamed or drilled holes shall be cylindrical and perpendicular to the member, and their accuracy shall be the same as that specified for punched holes except that, after reaming or drilling, 85 of any group of 100 contiguous holes in the same surface, or in like proportion for any group of holes, shall not show an offset greater than  $\frac{1}{32}$  inch between adjacent thickness of metal.

6.19. *Drifting of Holes.* The drifting done during assembling shall be only such as to bring the parts into position, and shall not be sufficient to enlarge the holes or distort the metal. Holes that must be enlarged to admit the rivets shall be reamed.

6.20. *General Reaming.* General reaming shall be required for all work under this Contract.

All rivet holes in main members shall be sub-punched and reamed, or drilled from the solid. This requirement shall not apply to holes for shop rivets in lateral members, sway bracing, and secondary floor members, and to the lateral plates and connection angles connecting these members to the main members of the structure. Connection plates or other parts acting both as main member material and secondary (lateral, sway bracing, etc.) member material shall generally have sub-punched and reamed holes in locations engaging similar holes in main members.

Reaming shall be done after the pieces forming a built member are assembled and firmly bolted together. No interchange of reamed parts will be permitted.

**6.21. Reaming of Field Connections.** Holes for all field connections shall be sub-punched and reamed or drilled with the connecting parts assembled, or else reamed or drilled to a metal templet not less than 1 inch thick.

Splices in the arch ribs shall be reamed assembled with their splice plates in place and the members lined up perfectly, the surfaces milled for bearing being drawn into tight contact.

**6.22. Shop Assembling.** All surfaces of metal to be in contact when assembled shall be carefully cleaned to remove all dirt, loose mill scale or other foreign matter.

The component parts of a built member shall be assembled, drift-pinned to prevent lateral movement, and firmly bolted to draw the parts into close contact before reaming, drilling or riveting is begun. Assembled parts shall be taken apart, if necessary, for the removal of burrs and shavings produced by the reaming operation.

The members shall be free from twists, bends or other deformations.

Preparatory to shop riveting full-size punched material, the rivet holes shall be cleared for the admission of the rivets by reaming.

End connection angles, stiffener angles, etc., shall be carefully adjusted to correct locations and rigidly bolted, clamped, or otherwise firmly held in place until riveted.

**6.23. Match-Marking.** Connecting parts assembled in the shop for the purpose of reaming or drilling holes in field connections shall be match-marked, and a diagram showing such marks shall be furnished to the Engineers.

**6.24. Rivets.** The diameter of the rivets indicated upon the Plans shall be understood to mean their diameter before heating.

Heads of driven rivets shall be of approved shape, concentric with the shanks, true to size, full, neatly formed, free from fins and in full contact with the surface of the member.

**6.25. Field Rivets.** Field rivets, for each size and length, shall be supplied in excess of the actual number to be driven to provide for losses due to misuse, improper driving, or other contingencies. Rivets shall be free from furnace scale on their shanks and from fins on the under side of the machine formed heads.

**6.26. Bolts and Bolted Connections.** Bolted connections shall not be used unless specifically authorized. Where bolted connections are permitted the bolts furnished shall be unfinished bolts (ordinary rough or machine bolts) or turned bolts, as specified or directed by the Engineer.

Unfinished bolts shall be standard bolts with hexagonal heads and nuts. The use of "button head" bolts will not be permitted. Bolts transmitting shear shall be threaded to such a length that not more than one thread will be within the grip of the metal. The bolts shall be of lengths which will

extend entirely through their nuts but not more than  $\frac{1}{4}$  inch beyond them. The diameter of the bolt holes shall be  $\frac{1}{16}$  inch greater than the diameter of the bolts used.

Holes for turned bolts shall be carefully reamed or drilled and the bolts turned to a driving fit by being given a finishing cut. The threads shall be entirely outside the holes, and the heads and nuts shall be hexagonal. Approved nut-locks shall be used on all bolts unless permission to the contrary is secured from the Engineer. When nut-locks are not used, round washers having a thickness of  $\frac{1}{8}$  inch shall be placed under the nuts.

**6.27. Riveting.** Rivets shall be heated uniformly to a light cherry red color and shall be driven while hot. The heating of the points of rivets more than the remainder will not be permitted. When ready for driving they shall be free from slag, scale, and other adhering matter, and when driven they shall completely fill the holes. Burned, burred, or otherwise defective rivets, or rivets which throw off sparks when taken from the furnace or forge, shall not be driven.

Loose, burned, badly formed or otherwise defective rivets shall be cut out. Caulking and recupping of rivet heads will not be allowed. In cutting out defective rivets care shall be taken not to injure the adjacent metal and, if necessary, the rivet shanks shall be removed by drilling.

Countersinking shall be neatly done and countersunk rivets shall completely fill the holes.

Shop rivets shall be driven by direct-acting riveters where practicable. The riveting machine shall retain the pressure for a short time after the upsetting is complete.

Pneumatic hammers shall be used for field riveting except when the use of other hand tools for riveting is permitted by the Engineer. A pneumatic buckler shall be used where practicable.

Special precautions shall be taken in the driving of rivets of extra-long grip, in order to secure the best possible results.

**6.28. Sheared and Flame-Cut Edges.** Sheared edges of carbon-steel material more than  $\frac{5}{8}$  inch in thickness, and of all alloy-steel material, shall be planed to a depth of  $\frac{1}{4}$  inch. Re-entrant cuts shall be filleted before cutting.

Carbon steel or alloy steel may be flame-cut, provided a smooth surface is secured by the use of a mechanical guide. Flame cutting by hand shall be done only where approved by the Engineer, and the surface shall be made smooth by planing, chipping and grinding. The cutting flame shall be so adjusted and manipulated as to avoid overheating the metal or cutting beyond the prescribed lines. All flame-cut edges of alloy steel shall be planed, chipped, or ground to a depth of  $\frac{1}{4}$  inch. Re-entrant cuts shall be filleted.

Filletts at re-entrant cuts shall have a radius of at least 2 inches, unless a different radius is specifically called for on the drawings.

**6.29. Planing of Bearing Surfaces.** Ends of columns taking bearing upon base and cap plates shall be milled to true surfaces and correct bevels after the main section of these members and the end connection angles have been fully riveted.

Caps and base plates of columns and the sole plates of girders and trusses shall have full contact when assembled. The plates, if warped or deformed, shall be hot-straightened, planed or otherwise treated to secure an accurate, uniform contact. After being riveted in place, the excess metal of countersunk rivet heads shall be chipped smooth and flush with the surrounding metal and the surfaces which are to come in contact with other

metal surfaces shall be planed or milled, if necessary, to secure proper contact. Correspondingly, the surfaces of base and sole plates which are to come in contact with masonry shall be rough finished, if not free from warps or other deformation.

Surfaces of cast pedestals and shoes which are to come in contact with metal surfaces shall be planed and those which are to take bearing upon the masonry shall be rough finished.

In planing the surfaces of expansion bearings the cut of the tool shall be in the direction of expansion.

6.30. *Abutting Joints.* Abutting ends of compression members shall, after the members have been riveted, be accurately faced to secure an even bearing when assembled in the structure.

Ends of tension members at splices shall be rough finished to secure close and neat, but not contact-fitting joints.

6.31. *End Connection Angles.* End connection angles shall be flush with each other and accurately set as to position and length of member. All floorbeams, and all other built-up girders having the same type of end connections, shall be milled on the ends to correct length after the end connection angles have been riveted on. The end connection angles of such floorbeams and girders shall, unless otherwise ordered, be set and milled on a slight skew, the angle of skew being computed so that the finished ends will rotate to a true vertical when the girders take their full dead load deflections. To insure a perfect end bearing, metal shall be cut from the faces of the end connection angles and from the ends of all web plates, flange material, and filler plates in the milling operation, but the end connection angles shall be so accurately fitted that not more than  $\frac{1}{16}$  inch will be taken off them at their roots. The abutting ends of cantilever beams shall be milled in the same manner. The end connection angles of each I-beam stringer shall be milled, or they shall be riveted in place while assembled with the whole stringer and clamped firmly in an iron frame which will give exactly the correct length of stringer and the correct position of the angles.

6.32. *Built Members.* The several pieces forming one built member shall be straight and close fitting. Such members shall be true to detailed dimensions and free from twists, bends, open joints or other defects resulting from faulty fabrication and workmanship.

6.33. *Lacing Bars.* The ends of lacing bars shall be neatly rounded unless otherwise indicated.

6.34. *Plate Girders.* Web plates of girders having no cover plates shall be detailed with the top edge of the web flush with the backs of the flange angles. Any portion of the plate projecting beyond the angles shall be chipped flush with the backs of the angles. Web plates of girders having cover plates may be  $\frac{1}{2}$  inch less in width than the distance back to back of flange angles.

When webs are spliced, not more than  $\frac{3}{8}$ -inch clearance between ends of plates will be allowed.

End stiffener angles of girders and stiffener angles intended as supports for concentrated loads shall be milled or ground to secure a uniform, even bearing against the flange angles. Intermediate stiffener angles shall fit sufficiently tight to exclude water after being painted.

Web splice plates and fillers under stiffeners shall fit within  $\frac{1}{8}$  inch at each end.

6.35. *Pins and Rollers.* Pins and rollers shall be accurately turned to detailed dimensions and shall be smooth, straight and free from flaws. The final surface shall be produced by a finishing cut.

Pins having a diameter of 7 inches or less shall be forged or rolled carbon steel. Pins having a diameter greater than 7 inches shall be forged and annealed.

Pins larger than 9 inches in diameter shall have a hole not less than 2 inches in diameter bored longitudinally through their centers. Pins showing defective interior conditions will be rejected.

6.36. *Boring Pin Holes.* Pin holes shall be bored true to detailed dimensions, smooth and straight, at right angles with the axis of the member and parallel with each other unless otherwise required. A finishing cut shall always be made.

The length outside to outside of holes in tension members and inside to inside of holes in compression members shall not vary from detailed dimensions more than  $\frac{1}{32}$  inch. Boring of holes in built-up members shall be done after the riveting is completed.

6.37. *Pin Clearances.* The diameter of the pin hole shall not exceed that of the pin by more than  $\frac{1}{60}$  inch for pins 5 inches or less in diameter, or  $\frac{1}{32}$  inch for larger pins.

6.38. *Welding.* Except where shown specifically on the Plans, welding of steel shall be permitted only to remedy minor defects, and then only with the approval of the Engineer.

All fusion welding shall be performed by the electric-arc process, and shall conform in every respect to the requirements of the 1936 Specifications for Design, Construction, Alteration, and Repair of Highway and Railway Bridges of the American Welding Society, and the qualification of welding processes and welding operators shall be in accordance with the requirements of Appendix E of the same specifications. Covered electrodes shall be used.

Steelwork shall not be painted on any areas where shop or field welding is to be done, except that a thin coat of linseed oil without pigment may be used as a temporary protection. After welding, the unpainted and welded areas shall be spot-painted with the shop paint used on the remainder of the steelwork, prior to the application of the field paint.

6.39. *Screw Threads.* Screw threads shall make close fits in the nuts, and shall be U.S. Standard, except that for diameters greater than  $1\frac{1}{2}$  inches, they shall be made with 6 threads to the inch.

6.40. *Pilot and Driving Nuts.* Two pilot nuts and two driving nuts shall be furnished for each size of pin, unless otherwise specified.

6.41. *Shoes and Base Plates.* Structural billets shall be finished top and bottom to the thicknesses and curved surfaces indicated by the drawings; all holes for bolts and anchor bolts shall be drilled; and all bolt holes shall be spot-faced unless the faces are finished.

6.42. *Arch Ribs.* The arch ribs are to be fixed at the skewbacks for all conditions of loading, and are to be without intermediate hinges. They shall be so cambered and erected that, under full dead load at a normal temperature of 50 degrees F., the axis of the rib shall conform to the outline shown on the Plans, the effect of rib shortening under full dead load being neutralized by the closure operations.

The ends of the rib sections shall be accurately faced to provide full bearing at the splices, the angle of facing being such as to secure radial splices under full dead load. The Contractor shall provide such methods of



control as to insure that each rib section shall be of accurate length, with the ends milled to the exact angles required. The bases of the skewback and grillage sections shall be plane and parallel; the billets, the rib, the grillage beams, and the stiffener angles shall be accurately faced to provide full bearing; and the lengths along the rib axis shall be exact.

The length of each rib section and the angles of the milled ends shall be checked carefully after milling, and any errors corrected in the milling of adjacent sections, in order to insure that the total length and shape of each rib shall be accurate. The rib sections shall then be shop-assembled in lengths of about 5 panels with the milled joints in tight contact, sections being added to one end of the assembly as sections at the other end are removed. The positions of the various splice points shall be checked at each stage of the assembly, no errors exceeding  $\frac{1}{32}$  inch being permitted. The method of assembly shall be such as will insure full bearing of the milled ends before reaming or drilling the rivet holes for the field splices, and will also permit inspection of the faced ends. If the joints are not in full bearing at each point of the assembly, the errors in milling shall be corrected. Since the assemblies must be made to cambered outlines, proper corrections shall be made from the dead-load outline of rib.

Flange angles and cover plates shall be bent to the rib outlines. The spaces between webs and cover plates at each end of each fabricated length shall be closed by caulking with oakum and lead wool after milling, all water and foreign materials being blown out with compressed air before closing the openings.

6.43. *Railings.* The sidewalk railing shall have posts of two 6-inch channels, top rails of 5-inch extra-strong steel pipe, bottom rails of 4-inch channels, and spindles of 1-inch square steel bars. The pipes and channels shall be true and straight, and each piece shall be cut to exact length; the spindles shall be straight and without twists or wind.

Each clear space between adjacent spindles, or between a spindle and a post, shall be made as nearly 5 inches as possible but shall not exceed this amount, the spacing being uniform for each panel of railing. All spindles and posts shall be set truly vertical, each panel of railing being fabricated on a skew conforming to the rate of grade at the location in which the panel is to be placed. The ends of the spindles shall have approximately round tenons which are to be set into holes drilled in the rails. The rails shall be drilled to receive the tenons of the spindles, the drilling being done with jigs which will insure an accurate spacing. The railing panels shall be assembled to templets, and they shall be firmly clamped preparatory to welding the joints. The faces of the spindles shall be set exactly on plane surfaces parallel to the center plane of the railing panel. Each end of each spindle shall be secured to the rail by a neat bead of electric-arc welding extending entirely around the spindle.

The roadway railings shall have posts of single 7-inch ship channels, top rails of 8-inch channels, bottom rails of 4-inch angles, and panels of  $\frac{3}{8}$ -inch plates. Channels and angles shall be true and straight, and plates shall be free from waves, twists, or buckles. Posts shall be vertical, and panels shall be framed on a skew conforming to the grade at the point where the panel is to be located. All parts shall be of correct lengths. Connections shall be by rivets or bolts, except that the plates shall be fastened to the top rails by welding. The upper ends of posts shall be coped and chamfered as indicated.

All materials for railings shall be copper-bearing structural steel or copper-bearing steel pipe.

Adjacent railing panels shall be securely attached to the intermediate posts. The panels shall be removable without removing any post.

The railing shall be adjusted accurately to alignment and grade. The adjustment shall be made by means of field reaming or drilling the holes for the connecting rivets or bolts, these holes being either sub-punched or left blank in the shop.

6.44. *Floor Joints.* The steel for the floor joints at the ends of the arch span shall be fabricated by electric-arc welding and riveting. The two parts for each joint shall be assembled together in the shop to insure a perfect fit, with temporary fillers in the  $\frac{1}{4}$ -inch clearance spaces between adjacent fingers, and the fingers shall be attached to the angles and plates by spots of welding while they are so assembled. Finally the fillet of welding for each finger shall be extended entirely across the area of contact between the finger and the angle or plate. Header pieces shall be added at the rear ends of the fingers, and securely welded in place. Steel bars for anchoring the joint material to the concrete work shall be riveted to the joint material. The pieces shall be match-marked, and they shall be erected in accordance with the match-marks. The various pieces shall be adjusted to correct position and with uniform clearance spaces between the fingers before drilling or reaming the rivet and bolt holes, in the field, for the connections to the stringers, which holes shall be sub-punched or left blank in the shop. Shims shall be provided as required. The removable sections of the joints shall be fastened down by bolts with springs between the nuts and the steelwork. The joints shall fit together perfectly and they shall operate freely.

The floor joints in the roadways located about 100 ft. from the center of the span shall be formed by steel castings resting on shelf angles supported on the stringers and floorbeams. The castings shall provide an anti-skid pattern of a type approved by the Engineer. The holes for connecting rivets shall either be sub-punched in the shop and reamed to size in the field after erection and adjustment, or left blank in the shop and drilled in the field. The joints shall be lined up perfectly, so that the floor castings will have full and even bearing, and be quiet under traffic. Any finishing, adjustment, or shimming required to secure this result shall be done by the Contractor. The cast plates shall be fastened down by bolts with springs between the nuts and the steelwork.

The floor joints in the concrete approaches shall consist of plates and angles with copper gutters as indicated. They shall be set accurately to position, and shall be firmly anchored to the concrete.

Expansion joints in curbs shall be adjusted and lined up accurately.

All structural steel in floor joints, together with their supporting details, shall be copper bearing.

The completed floor joints shall present a smooth even surface for traffic.

6.45. *Scuppers.* Scuppers and inlets in roadways shall be of cast steel, and those in sidewalks of cast iron. Drain pipe shall be wrought-iron pipe.

6.46. *Lamp Post Sockets and Bases.* Lamp post sockets shall be 7-inch double extra strong copper-bearing steel pipe. Sockets on steel spans shall have cast steel bases.

## MILL AND SHOP INSPECTION

6.47. *Inspection of Steel.* All material shall be subject to mill and shop inspection, except that, at the discretion of the Engineer, stock steel may be accepted for miscellaneous parts not subject to stress.

6.48. *Stock Steel.* No mill inspection will be required for stock steel. Stock steel shall be subject to surface inspection and cold bending tests only. Test pieces cut from stock materials shall endure bending cold, one hundred and eighty degrees, around a circle whose diameter is equal to the thickness of the test piece, without signs of cracking. One bending test shall be made upon at least one piece taken at random from every ten pieces of any particular size of plate, angle or other shape in stock; this requirement shall not apply to material ordered from the mill, which will be subject to the regular tests elsewhere specified. Full-sized rivets shall endure bending flat upon themselves without signs of cracking. The Contractor will be required to furnish the Engineer with two certified copies of the records of chemical analysis and physical tests of the stock steel to be used in the work.

6.49. *Notice of Rolling and Fabrication.* The Contractor shall furnish the Inspector with two copies of the mill order and give ample notice to the Inspector of the beginning of the work at the mill and shop, so that inspection may be provided. No material shall be rolled or fabricated before the Inspector has been notified where the orders have been placed.

6.50. *Cost of Testing.* Unless otherwise provided, the Contractor shall furnish, without charge, test specimens as specified herein, and all labor, testing machines and tools necessary to prepare the specimens and to make the tests.

6.51. *Rejection.* The acceptance of any material or finished members by the Inspector shall not be a bar to their subsequent rejection, if found defective. Any material accepted at the mills which, under the punches, shears, etc., shows hard spots, brittleness, laminations, piping, cracks, lack of uniformity in quality or other defects, shall be rejected and replaced by satisfactory material solely at the expense of the Contractor. Rejected material and workmanship shall be replaced promptly or made good by the Contractor.

6.52. *Marking and Shipping.* Members weighing more than 3 tons shall have the weight marked thereon. Bolts and rivets of one length and diameter, and loose nuts or washers of each size, shall be packed separately. Pins, small parts, and small packages of bolts, rivets, washers and nuts shall be shipped in boxes, crates, kegs or barrels, but the gross weight of any package shall not exceed 300 pounds. A list and description of the contained material shall be plainly marked on the outside of each shipping container.

The weight of all tools and erection materials shall be kept separate.

Anchor-bolts, washers, and other anchorage materials shall be shipped to suit the requirements of the masonry construction.

The loading, transportation, unloading and piling of structural material shall be so conducted that the metal will be kept clean and free from injury by rough handling.

## ERECTION

6.53. *Field Inspection.* All work of erection shall be subject to the inspection of the Engineer, who shall be given all facilities required for a thorough inspection of workmanship.

Material and workmanship not previously inspected will be inspected after its delivery to the site of the work.

6.54. *Handling and Storing Materials.* All steel members shall be shipped, trucked and handled in a manner that will cause no danger of

permanent deflection or other injury, and in a manner to be approved by the Engineer. In unloading girders or other heavy members from cars or trucks and in moving the same preparatory to raising into place, skids or rollers shall be employed and no material shall at any time be dropped, thrown, or dragged over the ground. Any bends, sags or kinks in material will be sufficient cause for its rejection. Material to be stored shall be placed on skids above the ground. It shall be kept clean and properly drained. Girders and beams shall be placed upright and shored. Long members, such as columns and arch rib sections, shall be supported on skids placed near enough together to prevent injury from deflection.

6.55. *Falsework.* Falsework shall be properly designed and substantially constructed and maintained for the loads which will come upon it. The Contractor shall keep all falsework in a safe condition, and shall provide such temporary stairways, gangways, staging, rope, railings, safety nets, etc., as the Engineer may direct, for the safety of the workmen and to facilitate thorough inspection and checking of the work during construction; but nothing herein contained shall relieve the Contractor from any responsibility for injury to persons or property. All timber used in connection with falsework shall be treated with a fire-retarding process approved by the Engineer. The Contractor shall avoid the use of timber falsework wherever possible.

6.56. *Methods and Equipment.* Before starting work, the Contractor shall inform the Engineer fully as to the method of erection he proposes to follow, and the amount and character of equipment he proposes to use, which shall be subject to the approval of the Engineer. The approval of the Engineer shall not be considered as relieving the Contractor of the responsibility for the safety of his method or equipment or from carrying out the work in full accordance with the Plans and Specifications. No work shall be done without the sanction of the Engineer.

6.57. *Protection of Masonry.* Before beginning erection, the Contractor shall effectively protect, by methods satisfactory to the Engineer, all masonry against damage or discoloration. The exposed surfaces of any timber near the masonry shall be treated with an approved fire retardant process. The Contractor shall be responsible for any damage to the masonry, and shall restore it to its original condition if injured or stained in any manner before final acceptance of the bridge.

6.58. *Preparation of Bearing Areas.* Bearing areas for arch skewbacks, column bases, and shoes are to be dressed to exact elevation by the substructure contractors. The Contractor is to make exact measurements across the river between arch skewbacks, which measurements are to be for the use of the substructure contractors in setting anchor bolts and finishing the arch skewbacks.

Bases and shoes shall have a full and uniform bearing upon the substructure masonry, and shall be rigidly and permanently located to correct alignment and elevation. They shall not be placed upon bearing areas which are improperly finished, deformed, or irregular.

6.59. *Setting Anchor Bolts.* Anchor bolts for arch ribs and for the columns of the steel approach spans shall be furnished f.o.b. the bridge site on the two sides of the river by the Contractor, and received, unloaded, stored, and set by the substructure contractors. When the Contractor is ready to set the bearings, he shall clean out the pipe sleeves; and after the bearing is lined up he shall fill the pipe sleeves with Portland cement mortar mixed in the proportion of one part cement to two parts fine aggre-

gate. Other anchor bolts shall be furnished and set by the Contractor, in holes drilled by the Contractor, using Portland cement mortar. The mortar shall consist of one part cement to two parts fine aggregate, mixed sufficiently wet to flow freely. The anchor bolts shall be set as follows:

Anchor bolts shall first be dropped into the dry holes to assure their proper fit after setting. They shall then be set as follows: Fill the hole about two-thirds full of mortar and by a uniform, even pressure or by light blows with a hammer (flogging and ramming will not be permitted) force the bolt down until the mortar rises to the top of the hole and the anchor bolt nut rests firmly against the metal shoe or pedestal. In case the mortar does not fill the hole, additional mortar shall be added. Remove all excess mortar which may have flushed out of the hole, to permit proper field painting of the metal surfaces.

The location of the anchor bolts in relation to the slotted holes in expansion shoes shall be varied with the prevailing temperature. The nuts on anchor bolts at the expansion ends of spans shall permit the free movement of the span.

**6.60. Setting Arch Skewbacks.** The arch skewbacks shall be set to exact position by the Contractor on the bearing areas which have been prepared by the substructure contractors. The Contractor shall be responsible for locating the skewbacks correctly, and shall make such exact measurements as may be required to secure this result. Any necessary correction of errors in the masonry bearing surfaces shall be paid for as Extra Work, unless such errors shall have resulted from inaccurate measurements made by the Contractor during the construction of the arch abutments, in which case the said correction shall be at the expense of the Contractor.

In case the Contractor desires to have any metal work for erection purposes encased in the substructure concrete, he shall arrange with the substructure contractors, at his own expense, for the placing of such metalwork, which metalwork will not be included in the weight paid for.

After the skewback grillages have been set to final position and before the skewback sections have been placed, the center cells of the grillage shall be filled with 1:2:3½ cement concrete. After the skewback sections have been erected and adjusted, the remaining concrete of the arch abutments shall be placed. In placing the concrete, particular attention shall be paid to the compacting of the concrete within and around the grillages, in order to insure that all spaces are completely filled and the concrete is everywhere in close contact with the steelwork. All joints between concrete and steel surfaces shall be sealed as hereinafter provided under the paragraph entitled Filling Spaces and Sealing Joints.

**6.61. Erection of Arch Ribs.** It is expected that the Contractor will erect the arch ribs with their lateral bracing by cantilevering out from both shores with the aid of tie-backs anchored into the rock cliffs. The location and details of the tie-backs and anchorages shall be such as will, in the judgment of the Engineer, render them safe for the loads imposed on them, and will avoid any danger of displacement of the rock or other damage thereto; but approval of the said tie-backs and anchorages by the Engineer shall not relieve the Contractor of responsibility for their strength and sufficiency.

The Contractor shall erect the arch ribs to accurate outline by methods that will avoid stressing them beyond the limits hereinbefore specified. In advance of beginning such erection, he shall submit to the Engineer, for

his check and approval, his detailed erection procedure, with computations of stresses and deflections at various stages. Excessive deflections or distortions of the ribs will not be permitted, and the two ribs shall be equally loaded at all times.

The center closure shall be made by a method that will insure that the axis of the rib will be of correct outline under full dead load at a normal temperature of 50 degrees F., and that the effect of rib shortening under full dead load will be entirely neutralized. In securing this result, the amount and position of the crown thrust shall be measured, by jacks or other approved means, after the erection tie-backs have been released and before final closure has been effected, and such adjustments made as will insure the correct condition of stress. The final closure shall then be made by a method that will not disturb this condition. The entire closure procedure shall be subject to the approval of the Engineer.

Riveting of the arch ribs shall follow closely the erection, and shall be done only when the milled joints are in full contact. All field splices in the ribs, with the exception of the closure point, shall be fully riveted before closure operations are begun.

6.62. *Handling Members.* The field assembling of the component parts of a structure shall involve the use of methods and appliances not likely to produce injury by twisting, bending or otherwise deforming the metal. No member slightly bent or twisted shall be put in place until its defects are corrected, and members seriously damaged in handling shall be rejected.

6.63. *Alignment.* Before beginning the field riveting the structure shall be adjusted to correct grade and alignment and the elevations of ends of floor beams properly regulated.

Unsatisfactory holes shall, at the discretion of the Engineer, be seamed to the next larger size after erection, and larger rivets used.

6.64. *Straightening Bent Material.* The straightening of bent edges of plates, angles and other shapes shall be done by methods not likely to produce fracture or other injury. The metal shall not be heated unless permitted by the Engineer, in which case the heating shall not be to a higher temperature than that producing a dark cherry red color. After heating, the metal shall be cooled as slowly as possible.

Following the completion of the straightening of a bend or buckle, the surface of the metal shall be carefully inspected for evidence of incipient or other fractures.

6.65. *Assembling and Riveting.* Splices and field connections shall have one-half of the holes filled with bolts and cylindrical erection pins (half bolts and half pins) before riveting. Splices and field connections in arch ribs shall have from 60 to 100 per cent of the holes so filled, as may be required by the erection stresses, the erection pins being tight-fitting.

Fitting up bolts shall be of the same nominal diameter as the rivets, and cylindrical erection pins shall be  $\frac{1}{32}$  inch larger.

Railings shall not be riveted or bolted until the dead load is on the structure, and after carefully setting as to grade and alignment.

6.66. *Adjustment of Pin Nuts.* All nuts on pins shall be thoroughly tightened and the pins so located in the holes that the members shall take full and even bearing upon them.

6.67. *Filling Spaces and Sealing Joints.* All spaces in steelwork shall preferably be arranged to insure draining, but any spaces that will not drain shall be filled with 1 :  $1\frac{1}{4}$  :  $3\frac{1}{2}$  cement concrete. The edges of this concrete shall be finished with slight grooves against the faces of the steel,

and these grooves shall be filled with a watertight seal of asphalt, to meet the requirement herein specified for Waterproofing on Concrete Surfaces, placed hot. Similar watertight seals shall be provided at all points where concrete abuts against steelwork. There will be no direct payment for the grooves and asphalt seals, but any concrete used for filling spaces shall be classified for payment as Concrete in Slabs and Curbs.

**Specifications for Performance.** In the performance-type specification the contractor guarantees to furnish an article which will serve a specified purpose and warrants its future performance in service. The satisfactory use of this type of specification depends upon the degree to which service requirements can be defined, measured, and proved by practical short-time tests. If this can be accomplished performance specifications are very suitable. The contractor is permitted maximum latitude in the design, thereby providing wide competition among manufacturers and great flexibility as to materials and workmanship. Indeed if performance is strictly adhered to in the specifications, only limited control may be maintained over the details of materials and workmanship. Performance specifications are particularly suitable for equipment, machinery, and some types of construction materials.

Mechanical and electrical equipment will be required in connection with most construction projects. When these items are of the nature of accessories and appurtenances, they are usually furnished by the contractor under the construction contract although they are sometimes obtained by the owner under separate contracts. The latter arrangement is usually made for large machines and equipment, such as heavy cranes, turbines, and engines. When machinery is procured under a special contract, both the construction specifications and the machine specifications should be explicit as to the responsibility for its erection and installation and the facilities required therefor, such as foundations, anchor bolts, and services. Also, provision should be made for the coordination of the machinery installation with the rest of the work.

With regard to the mechanical and electrical equipment included under the construction contract, the contents of the specifications will depend on the extent to which details of their design are furnished on the drawings. If the equipment is specially designed and all details of its construction are shown on the drawings, complete detailed specifications covering materials and workmanship are required, as for any other element of the project in as much as the owner is responsible for the design and therefore

for performance as well. Frequently, however, standard products of reputable manufacturers are adequate, or 'the manufacturer is required to furnish the detailed design of special equipment. In this case a somewhat different point of view is indicated in the preparation of the specifications. The usual practice is to specify type, power, capacity, efficiency, and the like, allowing the contractor latitude in the actual selection of the item and details of the design. The details of warranties as to sustained performance and durability, spare parts and tools to be furnished, together with installation instructions, should also be included. When performance is specified or the contractor is required to state and guarantee performance, the specifications should state explicitly how this performance is to be determined. Details of measurements and tests should be given. If the machine is unusual or complicated, consideration should be given to requiring the installation and tests to be performed under the supervision of the manufacturer. The specifications should be worded in such a way as to eliminate inferior equipment and the products of disapproved manufacturers.

Quality in the finished product must be guaranteed by warranty although some control in the design and manufacture is sometimes permissible by specifying the type and quality of the materials to be used in the various parts or elements of the article. It should be noted in this connection, however, that when standard products of recognized manufacturers are contemplated under performance specifications, any special quality requirements written into the specifications may be in conflict with manufacturing standards. Variation from manufacturing standards, of course, results in increased prices due to the special handling required.

With regard to the arrangement of performance-type specifications it will be advisable to follow an outline similar to the following.

- a.* General description.
- b.* Design and installation.
- c.* Operating conditions.
- d.* Performance requirements.
- e.* Special requirements as to quality.
- f.* Inspection and tests.
- g.* Warranty.



*EXAMPLE OF SPECIFICATIONS FOR PERFORMANCE*

## SECTION 9. CENTRIFUGAL PUMPS

9.01. *General Requirements.* Four pumps of the centrifugal mixed-flow or modified-propeller type having 54-inch diameter discharge outlets shall be furnished for the pump-well installation. Suction to each pump shall be through a single opening in the bottom of the pump casing which shall be flanged or otherwise arranged to receive an intake bell. Each pump shall be direct-connected to a vertical-shaft induction motor specified elsewhere herein. Pumps shall be of one manufacture and like parts shall be interchangeable. Each pumping unit shall be complete with all accessory equipment specified, indicated, or necessary for efficient operation. Anchor bolts and nuts for securing pumps to their bases shall be machine-finished cadmium-plated steel. The pumps will be inspected during construction, and shall be tested before and after installation as specified hereinafter. The performance data furnished with the bids shall be guaranteed.

9.02. *Services of a Supervising Erector,* who is well qualified by long training and experience in the installation of pumps of the type specified, shall be furnished by the pump manufacturer to supervise the erection of the pumps and place them in operation.

9.03. *Design and Construction.* Pumps shall be designed in accordance with the most approved practice, shall be efficient, quiet and reliable in operation, shall have maximum accessibility for examination and repair, and shall be constructed of materials which will afford maximum resistance to the corrosive action of salt water and a minimum of wear of all operating parts. Each pump assembly shall be free from critical speeds and harmful vibrations under all conditions of service. All passages through the pumps shall be of liberal area and contours shall be designed to reduce friction and eddy currents to a minimum. The design characteristics of the pumps shall be such as to insure satisfactory operation under parallel operation. All working parts, bonnet edges, and nut bearing surfaces and the faces of other supporting surfaces shall be machine finished. Each pumping unit shall be provided with base flanges, lugs or feet, which preferably shall be cast integral with the pump casting, for attachment to the pump-well structure, with the bearing surfaces drilled for holding down bolts. Pump outlets shall be located to conform with the general piping systems indicated and shall be arranged to provide for convenient disconnection. All flanged connections of pipe outlets on the pumping units shall be faced and drilled in accordance with the 125-pound American Standards. Flanged outlets on the pumps shall be not less than 2.25 inches thick.

9.04. *Pump Operating Conditions.* The pumps will take their suction from a common suction chamber at the bottom of the pump well, to which water will be conveyed through culverts, approximately 8 feet wide and 8 feet high opposite each pump. The arrangement and design of the pump well, as indicated on the drawings, is diagrammatic and only the general arrangement of the pumps and suction bells in reference to the suction chamber is intended.

9.05. *Capacity and Efficiency.* Each pump shall have an average capacity of not less than 96,000 g.p.m. of sea water when pumping against a total dynamic head varying from 20 to 54 feet. The total dynamic head is that defined for centrifugal pumps by the latest standards of the Hydraulic In-

stitute. The rated capacity of each pump motor shall not be exceeded under any load condition, including shut-off, that can occur in normal use of the pumps, and the speed of each pump shall not exceed 300 revolutions per minute. The pumps shall have characteristics such that the shut-off head shall be not less than 64 feet and the average overall efficiency, over the range of head between 20 and 54 feet, shall be as high as practicable. The average overall efficiency shall be defined as the ratio of the total work done to the power in-put to the motor, noted at increments of 5,000 gallons per minute, on the characteristic curve (between the two load-points mentioned) and averaged. The full load speeds of the pumps shall be less than  $\frac{1}{2}$  of their first critical speed.

9.06. *Pump Casings* shall be of the volute type without guide vanes or diffusers between the impeller and casing. Casings shall be divided in two or more parts in a manner which will best facilitate ready removal of the impellers and shafts without the necessity of breaking pipe joints or removing other important parts of the machinery. The inside surfaces of casings shall be smooth and the contours shall be designed to minimize friction and eddy currents. The parts of each casing shall be fitted with flanges which shall be accurately faced and drilled, shall be aligned with dowel pins or snug-fitted bolts, and shall be bolted together securely. Pump casings shall be close-grained high-test cast iron conforming in general to the Standard Specifications for Gray Iron Castings of the American Society for Testing Materials, Serial Designation A48-36, Grade 30, and having a tensile strength of not less than 35,000 pounds per square inch. Casings shall be fitted with renewable wearing rings of bronze having a zinc content not in excess of 5 per cent, and with suitable outlets at top for connection to a priming system. Bolts and nuts for casing joints shall be finished machine bolts and nuts conforming to the Standard Specifications for Heat-Treated Carbon Steel Bolting Material of the American Society for Testing Materials, Serial Designation A261-44T, except that bolts and nuts shall be cadmium plated after fabrication. Suitable inspection doors shall be provided in the casing covers to permit examination of the impellers without the necessity of opening the casing. Lifting eyes or other acceptable means shall be provided for handling the pump casings.

9.07. *Impellers* shall be cast in one piece and finished smooth; shall be designed to provide ample clearance and smooth passages between vanes so as to insure unobstructed flow of grit, solids and debris through the pumps; and shall be close-grained iron or semi-steel castings having a tensile strength of not less than 40,000 pounds per square inch (A.S.T.M. Spec. A48-36 Class 35). Impellers shall be fitted with renewable wearing rings of bronze as specified for the pump casings. Impellers shall be keyed on the shafts and secured thereto by lock-nuts or other approved means. The threading of the nut shall oppose the direction of impeller rotation. The lock-nut design shall be such as will eliminate the possibility of collecting debris. Each impeller, together with the rotating parts connected to it, shall be designed to insure that no objectionable vibration will develop at the operating speeds under any condition of service.

9.08. *Pump Shafts* shall be turned, ground, and polished to accurate dimensions at bearings, and shall be of ample size to resist bending, torsional, or other stresses to which the shafts may be subjected. The portion of the pump shafting outside the pumps shall be forged or rolled steel (A.S.T.M. Spec. A235-42 class G). Shafts inside pump casings shall be of nickel-copper-alloy, or rolled or forged steel with renewable, centrifugally-cast

nickel-copper-alloy sleeves designed to exclude salt water from contact with the steel. The renewable jackets shall be forced on the shafts, each jacket being secured by key and lock-nut. Each pump shaft at the impeller shall be tapered, keyed and locked in an approved secure manner. Joints in shafts shall be connected by forged steel shaft couplings.

9.09. *Stuffing Boxes and Sleeve Type Bearings.* Stuffing boxes for pumps shall be of adequate design to permit the satisfactory packing of the glands with an approved flexible metallic packing, and to reduce leakage to a minimum under all conditions of operation. The design of stuffing boxes, which are subjected to pressures above atmosphere, shall be such as will trap the leakage therefrom by the use of lantern rings or other approved means and return leakage by drain piping to the suction side of the pump. The glands shall be the same material as specified for the internal shafts. Ample drip pockets or drains shall be provided under the glands in all cases to permit proper drainage and to insure that no leakage from the glands will reach the bearings. The glands shall be split to allow their removal and to provide convenient access to the packing. Sleeve-type bearings shall be sufficient in number to maintain properly the shaft alignments and prevent whip, and shall have renewable linings of approved anti-friction bearing metal or alloy. Bearings shall be of proper proportions and sufficient size to insure cool operation. Bearing brackets and caps shall be of the same material as specified for the pump casings.

9.10. *Thrust Bearings.* Each pump unit shall be provided with a single thrust bearing of the Kingsbury type, located at the upper end of the motor shaft and designed to take the weight and thrust of the rotating parts of the entire pumping unit. The bearings shall be designed for the extreme possible conditions of loading and shall be of size sufficient for self-cooling. They shall be absolutely dependable, shall impose a minimum amount of friction and shall be self-aligning and as nearly as possible self-adjustable for wear. They shall not be dependent upon any external means for their lubrication. All wearing parts shall be accurately machined, ground and hardened. Provision shall be made for easy examination and for the renewal of parts. The bearings shall be of a design which has been successfully used in installations of similar size and type.

9.11. *Guide Bearings.* Each pump shaft shall be provided with a guide bearing at the intermediate gallery. These guide bearings shall be of liberal proportions and ample to prevent any noticeable vibration or deflection of the rotating shafting. The bearings shall be of the sleeve or anti-friction type, easily adjusted for position. The design shall admit of accurate erection, easy dismantling and the renewal of wearing surfaces, which in case of sleeve bearings shall be of bronze or genuine babbitt metal. The bearings shall run cool under all conditions, and the lubricating appliances shall be self-contained, automatic, and such as to require only occasional attention.

9.12. *Rigid Couplings* shall be provided in each pump shafting above the pump casing to permit the removal of the pump shaft and impeller without disturbing the position of the motor and at other points necessary for the installation and removal of the line shaft. Couplings shall have tight bolts and the coupling flanges shall be marked for selective assembly. The hubs or heads of couplings shall be of forged steel and shall be keyed on the shafts and secured by lock-nuts.

9.13. *Lubricating Apparatus* shall be provided for the proper and efficient automatic lubrication of all bearings of pumps and shafts and shall include all necessary auxiliary equipment, oil piping, valves, and accessories includ-

ing grease guns and brass lubricating fittings at greased ball bearings. The apparatus shall be of simple design consistent with maximum safety, easy accessibility, and minimum attention. Ball bearings may be arranged for grease or oil lubrication, unless approved specifically otherwise. In general, the maximum ambient temperature in service shall be assumed to be 120 degrees F.

9.14. *Designation and Marking of Pumping Units.* The direction of rotation shall be marked clearly by an arrow on the housing of each pump.

9.15. *Special Tools.* A complete set of special wrenches and special tools required for making adjustments, indelibly marked for the purpose intended and mounted on a suitable rack, shall be furnished with the pumps. (Ordinary adjustable wrenches are not required with the set furnished.)

9.16. *Painting.* All mechanical equipment shall be painted or enameled at the factory in accordance with the manufacturer's standard practice.

9.17. *Inspection and Tests.* Material and equipment shall be subject to inspection and tests at the place of manufacture and after installation. The testing code of the American Society of Mechanical Engineers, the standardization rules of the American Institute of Electrical Engineers, and the latest Standards of the Hydraulic Institute shall be followed in making the tests.

9.18. *Factory Tests* shall be made at the expense of the contractor. No painting or filling material shall be applied to castings until the latter have been inspected and passed. The pump casings shall be subjected to hydrostatic pressure tests of 50 p.s.i. and shall show no indication of leakage or other defects under the tests. Authorization from the Engineer shall be obtained before shipment is made.

9.19. *Tests after Installation.* Upon completion of the installation, the pumps shall be tested under the supervision of the pump manufacturer to demonstrate compliance with all the contract requirements and guarantees. The tests shall be conducted in the presence of the Engineer and shall be subject to his approval. The costs shall be borne by the contractor, including the services of supervising engineer and expenses incident to retests occasioned by defects and failure of equipment to meet contract guarantees at the first tests. Water, electric current, water level indicators and recorders, observers for taking readings, gauges and connections for measuring the velocity heads on the pumps shall be provided by the contractor. All test gauges shall be proven accurate to the satisfaction of the Engineer. All defects disclosed in the equipment by those tests shall be made good by the contractor or the equipment replaced by him without additional cost to the owner. Tests after installation shall include the following:

(a) *Operating tests* as in service shall be given all pumps. The alignment of each pump and motor unit shall be proven straight and plumb and the satisfactory operating of each pump unit shall be demonstrated.

(b) *Performance and efficiency tests of the pumps* shall include tests to prove the guaranteed capacity and approximate efficiency of one pump, as selected, and shall include:

(1) *Capacity and overall efficiency.* The work done by the unit shall be determined by multiplying the total weight of water pumped by the average total head. The overall efficiency shall be the ratio of the total work done to the power input to the motor, both expressed in foot-pounds. During the tests, readings will be taken from a depth gauge on the basin walls which will be marked to give the elevation of the water at 10-minute intervals, and with these readings the quantity of water pumped shall be

determined from the basin volume curve. The basin volume curve will be furnished by the Engineer.

(2) *Total dynamic head.* Readings simultaneous with the capacity readings shall be taken of the head in feet as determined by calibrated gauges in the suction and discharge connections of the pump; the gauge in pump discharge connection shall be located on the inboard end of the check valve.

(3) *Power input.* Readings simultaneous with the capacity readings and total-head readings shall be taken of the power input to the motor as determined by calibrated polyphase watt-meters and current and potential transformers placed in the circuit and near the motor.

(4) *Pump test performance curves.* Pump characteristic curves shall be prepared from the pump test data by the contractor and shall be furnished to the Engineer in triplicate.

9.20. *Warranty.* The contractor shall warrant the pumps and all accessory equipment furnished therewith to be free from defects of material and workmanship for a period of one year from date of acceptance; and he shall upon notice promptly make good at his own expense all defects developing during this period.

**Specifications for Proprietary Commodities.** Many of the materials and appurtenances of construction are manufactured and sold under patents, trade secrets, and other proprietary conditions. These so-called "standard brand" products are utilized in practically all construction work. Inasmuch as no control over manufacturing methods can be enforced, it is necessary for the engineer to be familiar with the quality and character of the various standard products on the market and to word the specifications in such a way that suitable products will be obtained while those considered unsatisfactory will be eliminated. It is inappropriate, and in public works illegal, to specify trade names or brands because to do so confines the selection to one manufacturer whereas most of such commodities are sold competitively by several manufacturers.

When it is practicable the most satisfactory method for procuring proprietary commodities is by means of quality or performance-type specifications setting forth the required properties and characteristics and the tests which are to be applied to prove them. Under this type of specification any proprietary commodity which meets the specified requirements is acceptable.

In many instances quality and performance specifications are not feasible, and some other method must be adopted. Traditionally it has been customary to specify one selected brand or trade name followed by the qualifying "or equal" phrase. This has been a chronic trouble maker during construction because of

the lack of suitable methods for determining equality when a substitute is proposed by the contractor and because of failure to designate who shall decide questions of equality. The latter objection can be overcome partially by providing for the engineer's decision to be final on such matters and by writing the qualifying phrase "or approved equal." In the absence of suitable tests, however, the determination of equality is always uncertain and subject to criticism by contractors and manufacturers alike. Moreover, the contractor has no means of knowing what will be considered equal when he is preparing his bid, and therefore he is forced to base his estimates on the brand named notwithstanding the fact that a lower price might be obtained by using a competitive product. If both products are equally satisfactory the owner should receive the benefit of the lower price, but few contractors will assume the risk involved in the uncertain equality question. Therefore, the "or equal" clause is not recommended except for minor items.

When it is necessary to procure proprietary commodities by trade or brand names, probably the most satisfactory method is to include a clause in the general provisions to the effect that the brand names specified are to be used as the basis of the bid and furnished under the contract but if the contractor desires to use products other than those specified he should so state in his bid, giving the details of the proposed substitution and the adjustment to be made in his bid if the substitution is approved. A similar procedure may be followed if the contractor for any reason desires to make a substitution during construction, but the contract or specifications should state that after the execution of the contract the engineer's decision on substitutions shall be final.

An alternative method which has some advantages consists of a list in the specifications of all brands or models which would be acceptable for a given purpose with a provision for additions to be allowed if it is desired that the products of other manufacturers be approved as substitutes before the award of the contract.

**Selection of Specification Type.** For most of the basic types of construction, such as timber, structural steel, concrete and masonry, the materials and workmanship type of specification is almost always used on important work. For these types of construction, rigid control of the methods of manufacture, composition, character, and physical properties of the components

is practicable. It should be noted that the cost of inspection and tests required under this type of specification may not be justified on smaller projects particularly with regard to the procurement of materials. Most materials are obtainable from reputable well-known manufacturers, and for minor work it is sufficient to permit such materials to be procured from stock thus dispensing with mill inspection, chemical, metallurgical, and physical tests, and the like. This will usually result in a reduction in costs.

Large specially designed and specially built machines will also require materials and workmanship specifications. Other equipment and machinery manufactured in standard models can usually be obtained best under performance and quality specifications. Likewise, this type of specification is indicated for special-purpose materials, such as waterproofing compounds and fire-resisting materials.

Many standard brand products, such as those desired for character, texture, appearance, and the like are not adaptable to performance specifications. For commodities in this classification a list of acceptable brands is indicated in combination with a clause in the general provisions providing methods for approval of substitutions.

**Basis of Measurement and Payment.** When the work is to be accomplished under a unit-price contract it is necessary to specify the base units for each of the bid items and the details of the methods to be used in arriving at the actual quantities of units completed under the contract. The latter procedure usually requires a combination of field measurements and mathematical calculations and is a common cause of controversy. For instance, earthwork is normally paid for on a cubic yard basis, the quantity being computed from cross sections taken before and after the completion of the work. The quantities are computed by the average-end-area method or more accurately by the average-end-area method combined with prismatical corrections. The latter method is laborious and tedious to apply and is seldom used in current practice, but unless the specifications cover this point uncertainty will exist inasmuch as the two methods never agree exactly. Likewise, structural steel is usually paid for by the pound or ton, and payment may be based on the actual weights shown on the shipping lists or computed from the dimensions

shown on the drawings and the weights given in the steel handbooks. Theoretical and actual weights seldom agree exactly, and the specifications should be explicit as to which method is to be used. These examples are cited because they have been the sources of many disputes and lawsuits.

Alternative methods of measurement are sometimes permitted but almost always lead to controversies because of discrepancies between the results given by the alternative methods. Therefore this practice is not recommended when it can be avoided. In earthwork, measurement of quantities is sometimes permitted on the basis of truckloads in lieu of volumes computed from cross sections. Truck measurement is, of course, inaccurate because of the bulking of excavated soil and variable quantities loaded into trucks. Dredging contracts frequently permit barge measurement of the excavated material in lieu of cross-section measurements. Conversion factors of from 20 per cent to 40 per cent, depending on the material, are usually specified, however, to make allowance for the swelling of dredged material in the barge as compared with cross-section measurements in place. To avoid these discrepancies earthwork quantities should always be measured in excavations, such as cuts and borrow pits, rather than in fills because disturbed earth usually requires years of consolidation before it settles to its original volume.

Precise definition of the units of measurement is essential particularly when one type of construction is subdivided into several classifications. Examples are found in concrete construction where one class of concrete may be used for foundations, a second class for columns, and perhaps a third class for beams and slabs. Each class will consist of a different mixture and will be paid for at its own price. Similarly, excavation may be subdivided into earth excavation and rock excavation each at its own unit price. Earth excavation usually includes all soil and loose rock which does not require special equipment for handling while rock excavation is usually defined as solid ledge rock, requiring blasting for removal, and large boulders exceeding a certain specified size, usually one-half a cubic yard. Unless careful distinction is made between these classifications controversies are bound to occur because of the wide range in unit prices.

With regard to the basis of payment to the contractor, the specifications should state explicitly how payment is to be made for



each element of the work. The work included under each bid item should be carefully described. Particular care is necessary to make certain that provision is made for payment of every part of the work in one place or another in the specifications and that no element of the work is paid for more than once. For work required but not listed as a bid item, reference should be made to the item under which payment is included. For example, in highway construction on a unit-price basis, the material from excavations is utilized for the construction of embankments, and the price bid for excavations includes payment for placing the excavated soil in fills. Although the specifications contain specific instructions covering the methods for constructing embankments no direct payment is made therefor. Likewise, payment for fine grading and preparation of the subgrade might be included in the unit-price bid for pavement. Also in some classes of earthwork it is impracticable to excavate to the exact theoretical outlines shown on the drawings, and the specifications should state the maximum variation from the theoretical limits for which payment will be allowed, it being understood that greater variations than the prescribed maximum will be at the contractor's expense.

The foregoing examples illustrate questions which may arise in connection with almost every type of construction. Therefore, the specifications should prescribe clearly the basis of measurement and payment for each item in the bid. Measurement and payment instructions should be inserted in the specifications in a titled paragraph at the end of each section of the technical provisions, or they may be collected for all bid items and placed in a special section of the technical provisions at the end of the specifications.

#### *ABBREVIATED OUTLINE SPECIFICATION FORM*

The foregoing discussions and examples of specification writing were based on the use of traditional style, composition, and grammar. In practice, it has frequently happened that such specifications have been so filled with legal phraseology as to become primarily legal instruments and only secondarily construction specifications. Furthermore, many specification writers have adopted the practice of applying certain stock phrases and stereotyped expressions to each requirement in the specifications. In

most instances such repetition adds nothing to the strength of the specification and may obscure its meaning. To avoid this situation Mr. H. W. Peaslee has proposed a new form without sentence structure. This form subdivides the specification into two separate specialized writing operations.\*

Part 1. For Lawyers—to distil the essence of the contract and to draft a single iron-clad condition to the effect that *everything* listed thereafter, material or operation, shall be put into the job, subject to qualification, condition or exception noted.

Part 2. For Technicians—to distil the construction essentials, boiling down to a clear concise analysis of materials and methods—An Outline of Requirements. With the body of the specifications left free for technical details only, the specification writer may then express his requirements in clear concise form in headings and sub-headings, without sentence structure, using phrases in preference to clauses, with only essential adjectives or adverbs, with no articles, definite or indefinite, unless positively required.

The outline form is best illustrated by the following examples of actual specifications which are quoted from Mr. Peaslee's original article:

#### CASE EXHIBIT A

##### APPLICATION OF MEMBRANE WATERPROOFING

*A typical old line form using a sentence structure with incessant repetition of mandatory provisions in each sentence. Cross references by italicized letters show where descriptive requirements of this form recur in the tabulated requirements of the streamlined form.*

*A streamline specification with a single governing mandatory provision followed by headings and subheadings only in phrase form.*

a. Surfaces to which waterproofing is to be applied shall be free

"Mention herein or indication on drawings of articles or materials, operations, or methods, requires that the Contractor shall provide each item listed—of quality, or subject to qualifications noted; perform according to conditions stated each operation prescribed; and provide therefor all necessary labor, equipment, and incidentals."

a'. Condition of surface to be waterproofed: free from holes, cracks, pro-

\* From "Streamlined Specifications," by H. W. Peaslee, *F.A.I.A. Pencil Points*, August, 1939.

from holes, cracks, projections, and conditions that would prevent complete adhesion of waterproofing.

*See a'*

b. Waterproofing shall not be applied at temperatures lower than 50 degrees F.

*See b'*

c. The application of waterproofing material shall be done in the most workmanlike manner and only by firms and workmen thoroughly familiar and experienced in this class of work.

*See c'*

d. Surfaces to receive 3-ply membrane waterproofing shall be uniformly coated with hot coal-tar pitch. Over this coating place 3 layers of 32-inch wide coal-tar pitch saturated felt, lapping each sheet 22 inches over the preceding sheet. Lap ends not less than 6 inches. (If 36-inch wide felt is used, lap sheets 24½ inches.) Mop each of the sheets full width of lap, with hot coal-tar pitch, using not less than 25 pounds per square for each mopping. Over the entire surface apply a uniform mopped-on coating of hot coal-tar pitch, using not less than 50 pounds per square.

*See x' & d'*

e. Surfaces to receive 5-ply membrane waterproofing with hot coal-tar pitch, using not less than 40 pounds per square. Over this coating place 5 layers of 32-inch wide coal-tar pitch saturated felt, lapping each sheet 26 inches over the preceding sheet. Lap ends not less than 6 inches. (If 36-inch wide felt is used, lap sheets 29 inches.) Mop each of the sheets full width of lap, with hot coal-tar pitch, using not less than 25 pounds per square for each mopping. Over the entire surface apply a uniform coating of hot coal-tar pitch, not less than 50 pounds per square shall be used.

*See x' & d'*

jections, and conditions preventing adhesion.

b'. Temperature for application:  
50 degrees F. minimum.

c'. Prequalification of firms and workmen: experience statement required.

x'. Materials: coal-tar pitch: and coal-tar-saturated felt.

d'. Method of Application:

Uniform coating of surface with hot pitch (40 lb. per sq.).

3-Ply Membrane: Over base coating

3 layers, 32" felt, lapped 22"  
or 36" felt, lapped 24½"

5-Ply Membrane: Over base coating

5 layers, 32" felt, lapped 26"  
or 36" felt, lapped 29"

end-laps, not less than 6"

each sheet mopped, full width of lap, with hot pitch (not less than 25 lb. per sq. for each mopping).

Entire surface mopped with hot pitch (not less than 50 lb. per sq.).

#### CASE EXHIBIT B

*This shows the repetition and waste of words in an actual specification which was originally supposed to be a brief one. Yet it contained:*

*489 repetitions of mandatory expressions.*

*4 to 5 pages of superfluous wordage.*

*34 descriptions of named trade products; and*

*22 descriptions of materials covered by reference in federal specifications (for each of which it is necessary to send a nickel to Government Printing Office!).*

*The bold face type indicates superfluous words that are not essential to the clarity of the instructions. The italics are repetitious mandatory expressions which are covered in the streamlined system by a single paragraph at the beginning of each specification section or in the General Conditions. The Roman type indicates the words remaining which are essential to the meaning of the instructions! Four to five pages could thus be eliminated.*

## SECTION 5. SEWAGE DISPOSAL

**5-01. Sewage Disposal.** A complete sewage disposal plant *shall be furnished and installed by the contractor and shall consist of the following parts:*

For each house: 1 Super-Septic Tank, No. 113; 1 Syphon and Syphon Compartment, No. 151.

**5-02. Absorption Field:** The contractor *shall provide* four 4-inch lines of open drain 30 feet in length from the "Y" in the soil line. The pipe of absorption field *shall be* common farm tile laid in gravel-filled trenches as detailed.

**5-03. Vitrified Pipe:** The sewer line from the septic tank to the absorption field *shall be* 4-inch pipe.

## SECTION 6. EXCAVATION

**6-01. Excavation.** The kind of material to be encountered in excavation is believed to consist of shale. Excavation *shall be made for* the cellars, garage and porches to the depth shown on the drawings and and for a distance of 6 inches outside of all exterior footing lines. All trenches *shall be* excavated to a neat size and each is to be leveled to a line on the bottom ready to receive foundations. Any excavations made below grade for the footing or walls *shall not be* filled before the footings or walls have been constructed on the undisturbed earth.

**6-02. Shoring.** Shoring and bracing *shall be furnished and placed* wherever there is any likelihood of a slip occurring and the cost thereof *shall be* included in the contract price.

## SECTION 7. CONCRETE FOOTINGS, FLOORS, WALKS, AND CEMENT BLOCK WALLS

**7-01. Footings.** All footings *shall be* constructed of concrete to the elevations shown on the drawings. Footings *shall rest* on undisturbed earth or other foundation satisfactory to the contracting officer.

**7-02. Concrete Floors.** The floors in the basement *shall be constructed of concrete* 4 inches thick, monolithic, smooth finish with uniform slopes to floor drains as indicated on the drawings. A 6-inch cinder fill *shall be made for the concrete basement floor. The porches shall have a*

5-inch concrete slab reinforced with triangular wire mesh **similar and equal to**. . . .

**Selection of Specification Form.** Much space in the specifications may be saved by the use of the outline form, particularly in specifications for building construction. The objectives of this form, however, may be accomplished largely with the older type of composition if the same general principles are applied, that is, by the elimination of extraneous, indefinite, and repetitive statements throughout the body of the specifications. If this is done the specification, though still somewhat lengthier than the outline form, will be clearer and more readily understood. Under these conditions it appears that the older type of specification is more desirable although individual requirements or personal preference may lead to the selection of the alternative form. Perhaps the most important element in the selection of form is the fact that any form or style whatsoever is acceptable if the requirements are definitely expressed in a clear, direct manner.

### Questions

1. Explain the differences between the general or supplemental conditions of the contract, the general provisions of the specifications and the technical provisions of the specifications.

2. Define three types of technical specifications.

3. Select the type of specification to be used for each of the following construction items, and give reasons for each selection.

- a. Concrete work.
- b. Excavation.
- c. Electric refrigerators.
- d. Bridge cranes.
- e. Electric elevators.
- f. Brick masonry.
- g. Asphalt roofing.
- h. Floor-hardening compound.
- i. Painting.
- j. Pump motors.
- k. Automatic sprinkler system.

4. What are the advantages in using standard specifications for materials and what precautions must be observed in their use?

5. Outline the general properties to be covered in the preparation of technical specifications for construction materials.

6. Outline the general procedure to be followed in writing the technical specifications for workmanship.

7. Outline the procedure to be followed in writing technical specifications based on the performance of the finished product.

8. Write the specifications for electric refrigerators to be installed in a high-grade apartment house. Each refrigerator is to have a capacity of 6.5 cubic feet. Only first-class standard models of recognized manufacturers are to be acceptable. Consult catalogs for manufacturers, models, and grades.

9. Write the basis of measurement and payment clause of the specifications for reinforced concrete pavement. Would actual measurement of the pavement on slopes be necessary or could areas be computed from the stations shown on the plans? If the pavement is 30 feet wide and extends from station 0 + 00 to station 10 + 00 on a 5 per cent grade, what would be the difference between the actual area measured on the slope and that computed from stations shown on the plans?

10. Describe two methods of measurement and payment for vitrified clay-pipe sewer construction in which the diameter of the sewer in various locations is 8, 10, 12, and 15 inches and the depth of invert varies from 6 feet to 12 feet for the 8-inch pipe, 8 to 14 feet for the 10-inch pipe, 12 to 18 feet for the 12-inch pipe, and 12 to 20 feet for the 15-inch pipe.

11. In an excavation contract on a unit-price basis, rock excavation was defined as ledge rock which would require blasting for removal and was priced at \$5.00 per cubic yard. All other excavation was classed as earth excavation, priced at \$1.00 per cubic yard. The site of the work was in a built-up section of a city. Because of the proximity of buildings and streets and fears as to what blasting would do to them, the contractor resorted to removal of the rock by the jack-hammer method, himself absorbing the considerable difference between the cost of blasting and the method used. The owner refused to recognize the rock excavation and insisted it should be paid for at the price bid for earth excavation because there was no blasting. The contractor sued the owner for the higher price for the material removed by the jack-hammer method. What was the decision?

## II

### PRINCIPLES OF SPECIFICATION WRITING

The qualifications of a competent specification writer are that he should have full knowledge and understanding of the work to be accomplished, definite ideas as to the materials and methods which should be used, and the ability to express these ideas in the specifications and drawings in a manner readily understandable by those who are responsible for the execution of the work. The engineer is assumed to possess skill in design and construction as the basis of his professional status, but his technical knowledge is of little value as far as the specifications are concerned unless he can make his ideas clearly understood not only by other engineers but also by manufacturers, construction superintendents, foremen, and workmen, many of whom may have had little or no technical training.

The technique of specification writing depends on the application of a few basic principles relative to grammar, word usage, subject matter, and composition. The mandatory and legal character of the specifications requires great precision in wording and punctuation as compared with most other types of writing. There are cases on record where an error in punctuation, a misplaced comma, for instance, has changed the entire meaning of a sentence and provided the basis for a lawsuit for extra compensation in which large damages were assessed against the owner because his engineer did not detect the error before the award of the contract. It is evident therefore that unless the specifications are properly written the objectives and precautions of the design may be endangered.

The introduction of legal phraseology in the technical specifications for the purpose of protecting more fully the rights of the interested parties and to counteract or comply with conditions imposed by decisions of previous lawsuits has resulted in confusing and sometimes misleading instructions. Legal phraseology is rarely necessary in the specifications if the other contract docu-

ments are properly prepared. Although the specifications, being part of the contract, have legal implications they should contain only the technical instructions necessary for the proper accomplishment of the work. Legal requirements related thereto should be written into the agreement.

Specification writing practice has developed through a long period of evolution in which early methods have served as models for later work. In many instances these methods which have been handed down are used from force of habit in situations where they are of no benefit, and they may even obscure the meaning intended. Experience on a large number of construction projects indicates that certain stereotyped clauses in the specifications chronically cause controversies and disputes. The suggestions which follow are intended to formulate some of the principles of good specification writing and to point out some of the most common faults encountered in past practice.

**Grammar.** Specifications should be written in short, concise sentences, in the simplest style possible. The style and tense should be the same throughout. Unfamiliar words, words having more than one meaning, and unusual technical and trade expressions should be avoided. Hyphens, commas, and semicolons should be used sparingly, and, when they or other extensive punctuation appear to be necessary, consideration should be given to a revision of the sentence. Misplaced or omitted punctuation marks can sometimes change the meaning of a sentence completely. To avoid this possibility it is better to convert the clauses of a compound sentence into separate sentences each with its own subject and predicate. This may lead to a monotonous repetition of terms in short sentences, but the likelihood of typographical errors and misinterpretation will be reduced. Relative pronouns should not be used unless they are absolutely necessary. "Which" clauses almost invariably are indefinite and confusing. All sentences should be complete in accordance with the rules of grammar. Tabulations and schedules are frequently advantageous, but broken or telegraphic-type sentences are usually not clear.

**Precision in the Use of Words.** It frequently happens that questions relative to the intention of the specifications have to be settled independently of the original writer. For this reason it is important to use words in their exact meaning, otherwise more than one interpretation may be possible. Colloquialisms, unusual



technical words, and trade expressions should be avoided, or, if required, they should be defined in detail where used. Where a word may be interpreted in more than one way it is necessary to restrict its meaning to that intended or to use a more definite substitute. The following is a list of typical words which are frequently used incorrectly in specifications. The correct use of these and similar terms will tend to reduce ambiguity.

*Any, all.* "He shall make good any defects," should read, "He shall make good *all* defects."

*Either, both.* "Dolphins shall be placed on *either* side of the pier," should read, "Dolphins shall be placed on *both* sides of the pier." *Either* implies a choice.

*And, or.* "It shall be free from defects of workmanship *and* material which would impair its strength *or* durability." Interchanging the two words in this sentence results in an entirely different meaning. Although commonly used in legal documents, *and/or* is considered undesirable in specifications because it is an indefinite expression and indicates lack of certainty. *Or . . . , or both* is preferred.

Do not use apparent synonyms, e.g., *must* and *shall*, as different degrees of their mandatory nature may be inferred. Adopt one or the other, and use it consistently.

Avoid omission of the articles, e.g., "Contractor shall paint ceiling of office." This should read, "The contractor shall paint the ceiling of the office." Omission of articles leads to awkward composition.

*Will, shall.* Use *will* in connection with the acts of the owner and *shall* with reference to the contractor. This is not based on considerations of grammar but is a helpful distinction between the commitments of the owner and the obligations of the contractor.

*Resisting, resistant.* *Corrosion-resisting* is preferred to *corrosion-resistant*.

*Amount, quantity.* Amount should be used in connection with money; quantity when referring to volume, number of objects, and the like. The *amount* of the estimate refers to the total cost, but the *quantities* in the estimate are the numbers of the various units.

Avoid the use of *same* as a pronoun, as in, "If bracing is required the contractor shall furnish same at no additional cost."

Similarly, *said* should not be used as an adjective, as in "Said bracing shall be furnished at no additional cost."

**Subject Matter.** The subject matter of the specifications should be confined to the information and directions necessary for construction work after the award of the contract. All information pertaining to bidding procedure and conditions of bidding needed before the award of the contract belong in the instructions to bidders, and the word "bidder" rarely needs to appear in the specifications. Likewise, all information of a legal nature, such as time, payment, changes, and liquidated damage clauses, belongs in the contract and not in the specifications.

The specifications are intended to amplify, but not to repeat, information shown on the drawings. For example, the drawings show studs to be 2 inches by 4 inches and their spacing to be at 16-inch centers whereas the specifications should state whether they are to be southern yellow pine or Douglas fir and the grade required. The drawings show how the materials are to be incorporated into the structure. The specifications state the quality of the materials and workmanship to be employed. No information should be given in the specifications which is not necessary for the preparation of bids and the accomplishment of construction work, e.g., unit stresses and loadings which should be placed more properly on the drawings.

The specification writer should have definite reasons in mind for every requirement specified, but these reasons or explanations should not be given in the specifications because the reasons may become the cause of controversy. The justification for a specification requirement is a matter of engineering before the award of the contract and has no place in the specifications.

Cross references should be kept to a minimum, and paragraph numbers alone should not be used for this purpose. If it is necessary to refer to a particular paragraph, do so by its title and number and the section under which it is to be found. Cross references of the types, "Painting of the Woodwork is covered under Painting" and "Painting is specified hereinafter" are usually unnecessary.

**Balanced Composition.** A specification in its entirety as well as in its component parts should be commensurate with the size and importance of the work. Matters of major importance should be covered in detail while lesser items may warrant only a brief

explanation. There is a tendency among engineers to use standard specifications for such types of construction as concrete work, structural steel, and the like for all such work notwithstanding the fact that the standard specifications were probably prepared originally for large important projects and include many requirements and refinements which are not justified on small isolated structures. Cement for a large concrete dam, for instance, must be closely controlled in manufacture and subjected to mill and field tests throughout the work. The mixing, placing, and curing of the concrete likewise must conform to detailed technical requirements. The same procedure applied to a small culvert on a secondary road would, of course, result in an absurdity which would be a nuisance to everyone concerned and would increase the cost of the work. Similarly, standard-grade structural steel bought from stock is adequate for a minor structure whereas for a large bridge or building it will be desirable to control the composition, fabrication, and erection of the steelwork in great detail.

Broad general requirements should be reviewed carefully because they are applicable to all parts of the work and therefore will have a direct influence on the character and construction cost of the project. Special requirements, on the other hand, may apply to only a small detail and may have a minor effect on the job as a whole. The careless application of a broad general requirement may result in refinements unnecessary or even undesirable in some parts of the work. In general, it may be said that the most satisfactory specification contains a minimum of requirements consistent with the results desired.

**Definite Requirements.** The instructions in the specifications should be written in the form of specific directions and never as suggestions or explanations. Unless this is done there may be some doubt in the contractor's mind as to what is intended, leaving openings for him to propose substitutions and alternatives in his bid and during construction. He is within his rights in doing this if the specifications are not explicit as to what is required.

Such relative and indefinite expressions as *reasonable*, *best quality*, and the like, which are commonly found in specifications, should be avoided. They are difficult to enforce and have been the causes of many disputes because no fixed definitions are avail-

able. Similarly, the *or equal* clause frequently used in connection with specifications for proprietary commodities is indefinite. Although final decision in such questions is made by the engineer, the contractor has no way of knowing in advance what will be considered *reasonable, best, or equal*, and therefore he must protect himself against the most unfavorable interpretation likely to be made by the engineer. The expression *in accordance with standard practice* is somewhat more specific, but it also is too indefinite to be used other than in connection with minor items.

The expression *as directed by the engineer* is always indefinite because the contractor cannot predict in advance what the engineer will direct. Frequently it is necessary to leave some items to the discretion of the engineer, e.g., the color of paint or the exact location where the contractor may dump excavated material, and even then care must be taken that the arbitrary action of the engineer does not involve a change in cost. The specification writer indicates either laziness or incompetency when he takes refuge behind blanket clauses.

Indefiniteness results from certain words which crop up in specifications repeatedly. For example, when weights are given in *tons*, there is always a question as to whether 2,000 pounds or 2,240 pounds are intended. A distinction should always be made between *short tons* and *long tons*. Similarly when time is specified in *days* there is always a question as to whether *working days* or *calendar days* are intended. The latter is more definite and to be preferred. The abbreviation *etc.* at the end of a list of items is vague and indefinite and should never be used in specifications. It should be noted that, if more than one meaning can be taken from an expression in the specifications, the contractor is entitled to take the one most favorable to him inasmuch as the owner, not he, was responsible for the writing of the specifications.

These examples illustrate the necessity to be precise and definite in all respects when specification requirements are being formulated. Inaccurate wording and vague clauses almost always result in increased construction costs because contractors increase their bids to cover the possibility of arbitrary decisions during construction.

**Accuracy.** When information is given in the specifications it must be correct and complete. Unless special provision is made

to the contrary, the owner will be held responsible for the accuracy of the specifications and misleading information will be sufficient grounds for the contractor to collect additional compensation or damages if extra costs result. For example, borings taken every 100 feet on a sewer line might show no quicksand. If quicksand pockets were encountered between the 100-foot boring sections the contractor could claim and collect the extra cost of excavation. Technical information should be carefully checked for accuracy and completeness.

Repetition is a common source of errors in the specifications; therefore a requirement should not be repeated after it is once stated. Though repetition may sometimes serve for emphasis, errors and uncertainties result when corrections become necessary and are made in one place but are overlooked in another where the same statement occurs. A similar source of errors is that resulting from revisions in the drawings which are not followed through in the specifications.

The use of symbols lead to errors. Instead, write out or abbreviate the meaning of the term, e.g., 150 lb. instead of 150# and 2 ft. 4 in. instead of 2' 4". The latter may be mistyped 214". Other common symbols to be avoided are % for per cent, — for minus, + for plus, and the like.

Incorrect spelling and punctuation marks and typographical errors in the specifications may have serious consequences. Mistakes of this sort may completely change the meaning of a sentence and cause disputes or extra cost.

**Practicability.** It should be recognized that laboratory technique is not economically feasible in ordinary construction work, and procedures which are necessary in scientific research would be prohibitive in time and cost on a construction job. Moreover, the improvements which result from such refinements in most types of construction are not warranted when compared with standard production methods. Therefore the specification writer should recognize the limitations of materials and workmanship, and he should not specify practical impossibilities. Tolerances, clearances, finishes, and the like should be controlled only to a degree consistent with the functional, architectural, and structural requirements of the completed work. It is true that some work, such as delicate parts of a machine, require great precision, but much

money has been wasted through unnecessary requirements in types of construction where such refinements are not essential.

In so far as possible construction requirements should be adapted to standard sizes and patterns. Special sizes are expensive and require extra time for manufacture and delivery. Odd lengths of lumber have to be cut from the next larger standard size, and the waste will be charged to the special order. Variation from the standard shapes for structural steel sections require special rolling and such an order will be charged with the extra cost of setting the rolls and special handling. If rivet spacings different from steel fabricator's standards are called for, rivet holes have to be punched by hand at extra cost rather than by multiple-punch machines. Many other examples could be cited in which the economic advantages of mass production are lost by variations from standard sizes and patterns. Although the designer makes many of the decisions relative to dimensions, sizes, and patterns, the specification writer may accomplish a great deal along this line by constant vigilance to detect variations from established standards.

Whims and pet requirements frequently result in improper and uneconomical use of materials and construction methods. These may gratify the specification writer but are not appreciated and perhaps not known by the owner. Also, they may be a thorn in the flesh of the contractor during construction and increase the cost of the work whereas a more appropriate substitute could be used at less cost.

**Conflicting Requirements.** Conflicts between the various clauses in the specifications are the cause of much trouble in construction work. Conflicts which result from typographical errors, mistakes, lack of coordination between the drawings and the specifications, and the like can be corrected usually by carefully checking the manuscript before the specifications are issued. Other types of conflicts are more difficult to detect, however. Detailed technical requirements in one paragraph may produce results incompatible with those stipulated elsewhere in the specifications. For example, specifying the chemical composition of a material may produce strength and durability characteristics completely different than those required under physical properties. Unless the specification writer is thoroughly familiar with materials tech-

nology, such a conflict is not improbable. In fact, specifying both methods and results at any time in construction work is likely to lead to conflicts of this sort and may relieve the contractor of responsibility for the final results.

Another illustration of conflicts is sometimes encountered in pile driving specifications where both the penetration of the pile and its bearing capacity are specified. In some types of soil the required bearing power might be developed long before the piling had been driven to the specified penetration. In others the reverse might be true.

**Fairness.** The best interests of the work require that the specifications simply set forth the desired standards of quality and workmanship without imposing harsh and unfair conditions on the contractor. The engineer's first responsibility is, of course, to safeguard the owner's interests, but this should not be done by saddling the contractor with vague and indefinite specifications subject to unilateral interpretation by the engineer or by forcing the contractor to assume responsibilities which more properly should be placed on the owner or on the engineer himself.

An outstanding example of unfairness is the common practice of compelling the contractor to assume responsibility for the possible inaccuracy of information furnished by the owner. At all times the owner should be responsible for the accuracy and sufficiency of the information he gives to bidders or contractors. The interpretation of such information is, of course, the responsibility of the contractor. It is expected that the contractor will assume full responsibility for all of the normal hazards of his business, such as weather, changing labor rates and material prices, and the like, but if he also has to evaluate the effect of future acts of the owner or the owner's representatives and guarantee the accuracy and sufficiency of these acts, construction costs are bound to be increased.

When specific difficulties or hazards are known to exist in connection with the work, all available information related thereto should be furnished to the contractor. The contractor, of course, should be made responsible for the interpretation of such information. Difficulties and hazards should never be concealed from the contractor because to do so prevents him from making an intelligent bid and may impose unfair losses on him in the performance of the work. On the other hand he may suspect their

existence and include an excessive contingency item in the bid which would result in a greater cost to the owner than would have been the case if all facts were made known.

In every specification requirement the question arises as to the degree of responsibility to be imposed upon the contractor. If the quality of materials and workmanship are specified in detail the contractor can only be required to guarantee freedom from defects. With more general specifications, it is reasonable to require the contractor to assume more responsibility.

**Brevity.** Specifications should be written as concisely as possible without sacrificing clarity. Unless the provisions are brief and to the point with all non-essential wordage eliminated, their meaning may be obscured. A great deal can be accomplished along this line by avoiding verbose grammar and the repetition of stereotyped mandatory provisions in connection with each type of construction, whether needed or not. Literary style is desirable in many forms of writing, but it should be kept in mind that specification writing consists of a simple listing of directions for the contractor to follow in accomplishing construction work and simplicity and brevity are essential.

The following, quoted from actual specifications, illustrate how clarity and meaning may be lost by ponderous and verbose grammar.

Paint shall be of such character that it will protect the steel against corrosion without being injurious to the health of persons drinking the water after the latter has stood in the tank for three months.

Drain piping in and about the pump room to be supplied by the subcontractor whether entirely buried in concrete or not.\*

The effective length of spans will be the distance between the centers of gravity of end posts, and the centers of end shoes or end bearing plates must coincide therewith.\*

All materials which, subsequently to the tests at the mill and to its acceptance there, during manipulation, in the shops under shears, punch, etc., which shows it is not of uniform quality, as herein specified, and also hard spots, brittleness, cracks and other defects are developed; such material shall be rejected.\*

Traffic is now being carried on over the existing gap to be replaced by these two steel superstructure spans by means of a pile trestle temporary bridge.\*

\* From *Civil Engineering*, February, 1943, p. 107.



The repetition of expressions similar to "The contractor shall provide all materials and perform all labor in connection with each type of construction" contributes nothing to the strength of the specifications and should be avoided. One statement in the general provisions to this effect applied to all the work is binding in all cases except those specifically noted. The following is an example of an introductory paragraph which is frequently used for each section of the technical provisions, thereby increasing unnecessarily the bulk of the specifications.

Under this heading, the contractor shall provide all materials and perform all labor for the installation of all concrete, including reinforcement, necessary to the construction and completion of the work in accordance with the drawings, and specifications, and the intent thereof.

The above sentence means little, for unless the intent of the drawings and specifications is indicated more adequately elsewhere, the sentence cited adds nothing. For a particular project to which this might be applicable, the statement should be changed to read, "*General requirements.* Concrete work includes column footings, wall footings, first floor of storeroom, and pipe trenches." In most cases, this paragraph can be omitted altogether as a superficial examination of the drawings indicates clearly the exact limits of the various classes of work, and a definition of their scope in the specifications is superfluous.

The expression "as indicated on the drawings" is seldom necessary because the fact that a thing is shown on the drawings is a sufficient indication, making mention of it in the specifications unnecessary. Similarly, "in accordance with these specifications" should be omitted in practically all cases in the body of the specifications.

The dimensions of all concrete work and amount of steel reinforcement shall be as indicated on the drawings. Where not indicated, the walls and slabs shall be proportioned . . . etc. should read:

Where dimensions of concrete work and amount of reinforcement are not indicated, the wall and slabs shall be proportioned . . . etc.

Such statements as the following are unnecessary and should be omitted.

Expansion joints shall be provided in the concrete trenches where and as indicated on the drawings.

Manhole frames and covers shall be installed in the concrete manholes to provide access to the equipment. They shall be of the size indicated and shall be provided with cast iron frames and cast iron covers as shown.

The latter should be omitted entirely if marked properly on the drawings. If needed, it should be revised to read:

Manhole frames and covers shall be cast iron.

The expressions "to the satisfaction of the engineer," "satisfactory to the engineer," "subject to the approval of the engineer," "in an approved manner," and the like contribute nothing to the strength of the specifications and should be omitted for the sake of brevity. The contract should state once and for all that all work must meet the approval of the engineer, and repetition of this provision in the specifications is not necessary. Similarly repetition in the specifications of the expression "the contractor shall guarantee the work to be free from defects in materials and workmanship," means little. Where needed it should be revised to read "the contractor shall replace at his own expense any portion of the work found by the engineer to be defective." This requirement is enforceable but not needed any place in the specifications if the contract contains a general requirement that the contractor shall make good all defective work found any place on the job.

**Principles of Specification Writing Summarized.** The principles of specification writing discussed in the foregoing paragraphs may be summarized as follows.

1. Make a clear concise analysis of the job requirements as to general conditions, types of construction, and quality of workmanship.

2. Prepare an outline of the specifications, segregating topics to be covered in the general provisions and the technical provisions respectively and giving due consideration to the contents of the other contract documents.

3. Analyze each type of construction to be covered in the technical provisions to determine the type of specifications to be used, i.e., materials and workmanship, performance, or proprietary commodities.

4. Outline the requirements to be included in each section of the specifications, coordinating the subject matter with the drawings and the other contract documents.

5. Write each section concisely, using short sentences and simple composition.

6. Use words in their exact meanings.

7. Make each requirement definite and complete.

8. Give directions, never suggestions.

9. Do not give reasons for direct specification requirements.

10. Do not specify impossibilities.

11. Avoid conflicting requirements.

12. Give no information which is unnecessary for the preparation of bids and accomplishment of the work.

13. Specify standard sizes and patterns wherever possible.

14. Avoid whims and pet requirements.

15. Do not repeat information given on the drawings.

16. Do not repeat a thing once stated.

17. Do not repeat superfluous mandatory provisions when the same things are required in general by the contract.

18. Minimize the use of cross references.

19. Do not place upon the contractor the responsibility for the possible inaccuracy of information furnished by the owner.

20. Do not impose harsh and unfair conditions on the contractor.

21. Never conceal difficulties or hazards from the contractor.

### Questions

1. Rewrite the following specification clause to eliminate ambiguity. "Timber piles shall be driven to a minimum penetration of 60 feet below cut-off and/or a final penetration sufficient to develop a safe bearing capacity of 50,000 pounds as computed by the *Engineering-News Formula*."

*Note.* A controversy over the intended meaning of this clause in the specifications for the construction of a building resulted in the award of a large extra payment to the contractor.

2. Explain how the following specification clause is indefinite, and clarify the sentence. "Concrete shall be made of one part of Portland cement, two parts sand, and four parts gravel."

3. Show how it may be impossible to mix concrete in accordance with the following specification requirement. "Concrete shall be made of one part Portland cement, two parts sand, and four parts gravel. Seven gallons of water shall be used per bag of cement, and the slump, as measured by the standard slump test, shall not exceed 4 inches."

4. What are the advantages of specifying standard sizes and dimensions whenever practicable?

5. Give an example of unfair specifications.

6. Explain what is meant by "balanced composition" in specification writing.

7. What is the inherent danger in broad general specification requirements? Should such general clauses be used?

8. Give two commonly used examples of indefinite specification requirements.

9. What are the objections to the use of symbols in specifications?

10. Why should repetition be avoided in specifications?

11. Discuss the following phrases which are frequently used in specifications.

a. "As indicated on the drawings."

b. "To the satisfaction of the engineer."

c. "The contractor shall furnish all materials and labor required to construct. . . ."

d. ". . . shall be Type B as manufactured by Blank Company, or equal."

12. What are the advantages of simplicity and brevity in specification writing?

13. Explain how it may be difficult to detect conflicting requirements in specifications.

# I 2

## ASSEMBLING THE SPECIFICATIONS

The first step in assembling the specifications for a construction project is to make a careful analysis of the job requirements and a check list of the topics to be covered. The various items should be segregated into three classifications, namely, those which properly belong in the agreement, the general provisions of the specifications, and the technical provisions of the specifications, respectively. This involves a close study of the drawings to determine the aspects of the work which are not shown completely thereon and the supplemental instructions required in the specifications. The resulting check list or outline headings will then represent a breakdown of the project into basic operations and types of construction, and the specification writer may concentrate on each topic successively until all are prepared.

As each section of the specifications is completed, it should be checked by the designer of that particular phase of the work, and when revised or corrected it is ready for assembly into the combined volume of the specifications. When all sections are completed a final review of the plans and specifications should be made to detect any remaining errors, omissions, and duplications.

For use by contractors for the preparation of bids and for construction purposes in the field a considerable number of copies of the specifications will be required. The most suitable methods of reproduction will depend largely on the character and magnitude of the work. For large important projects the specifications are usually printed and bound with either heavy paper or cloth covers. Many offices use the mimeograph or hectograph processes in which the pages are reproduced, punched, collated, and bound in paper covers. For minor work a few typed carbon copies may be sufficient.

To illustrate the procedure of analyzing job requirements and assembling the specifications typical outlines are given in this chapter for representative engineering and architectural construc-

tion projects. The preparation of the specification outline for an important project is a lengthy process, and many general check lists have been prepared as guides for this phase of the work. Some of these are helpful expedients for the specification writer, but it should be emphasized that no standard check list ever written can be considered a satisfactory substitute for a careful analysis of the individual job. Likewise, specification handbooks are helpful but dangerous if used indiscriminately without a full understanding of the special requirements of the individual job. The following sample outlines of specifications are therefore given to illustrate the methods for setting up the specification requirements for construction projects and as a guide for practice in specification writing. The clauses discussed are intended only to indicate the proper form and composition.

**Title and Table of Contents.** The title should be short but definite and descriptive. It should give not only the location and character of the project but should also specify the services to be performed, as in the following example.

**SPECIFICATIONS FOR FURNISHING AND ERECTING THE  
STEEL SUPERSTRUCTURE FOR THE JAMESTOWN  
BRIDGE, JAMESTOWN, R. I.**

Though not absolutely necessary a table of contents listing section numbers, section headings, and page numbers is a convenience for reference purposes, particularly when the specifications are of considerable length. For some types of construction it may be desirable to list paragraph or subsection headings in the table of contents as well.

**Outline of the General Provisions.** Although many of the clauses of the general provisions can be more or less standardized for ordinary engineering and architectural construction work it should be noted that these general requirements frequently establish policy with regard to the entire project, and therefore they may have important effects on the cost of the work as compared with detailed requirements which may affect only minor elements of the work. Therefore, no general provision should be incorporated into the specifications until all of its implications are clearly understood.

The general provisions may be set up as Section 1 of the specifications, to be followed by the various sections of the technical

provisions in numerical order. Arabic numerals are used in contrast to the Roman numerals frequently adopted for the articles of the contract. In another method of composition which is also widely used, the general provisions comprise Part I of the specifications, and the technical provisions make up Part II with the sections of each part numbered independently. The former method is recommended in this book because it is believed to result in a more unified treatment of the specifications as a whole although the general provisions do not receive as much prominence in the documents under this arrangement as in the alternative method. The decimal reference method is used for numbering paragraph or subsection headings.

The following outline indicates the format of the general provisions. The suggestions as to composition are in accord with current practice, and the paragraph headings are typical of those required for engineering and architectural construction.

## SECTION 1. GENERAL PROVISIONS

**1.01. Description of the Work.** The description should be sufficiently complete to indicate the types of construction, the character of the finished product, and the scope of the work. Any unusual features or requirements should be mentioned.

**1.02. Location of the Work.** The geographical location of the work should be described briefly, mentioning also the methods of access to the site, such as railroad, highway, and water transportation facilities.

**1.03. Reference to Other Contract Documents.** Designate by reference the agreement, drawings, and other documents on which the contract is based.

**1.04. Contract Drawings.** List by number and title the drawings which accompany the specifications and which form a part of the contract. Where "as shown," "as indicated," "as detailed," or words of similar import are used in the specifications, it should be made clear that reference is made to these drawings unless stated otherwise. Also mention should be made of any reservations or restrictions as to the ownership and use of the drawings.

**1.05. Detail Drawings and Instructions.** Make provision for the engineer to issue from time to time during the progress of the work detail drawings and instructions necessary for the proper execution of the contract. These drawings and instructions are to be true developments of the contract drawings and inferable therefrom. They must be consistent with the contract documents and within the scope of the work under the contract.

**1.06. Reference Drawings.** Occasionally it may be desirable to list for the convenience of the contractor supplemental drawings which contain information necessary for the conduct of the work but which are not included in the contract drawings. Utility location drawings, boring logs and the like are typical of this classification.

**1.07. Work and Materials to be Furnished by Others.** If it is intended that any part of the work necessary for the completion of the project is to be furnished by the owner or by other contractors, complete information should be given. This will apply when the owner expects to furnish materials and equipment to be installed by the contractor; when the owner plans to accomplish part of the work with his own forces and when work is to be done under other contracts. This clause should require the contractor to conduct his operations in complete harmony with others engaged in the work and not to interfere with or delay the work of other contractors. When more than one contractor is to be employed, the work of each should be defined in detail, particularly if the same set of specifications is to be used by several contractors.

**1.08. Standard Specifications.** Standard specifications, such as those published by the Federal Government and the American Society for Testing Materials, are widely used for construction work, particularly for materials of construction. These standards may be incorporated into the specifications for any project by reference. Although such references are made in various sections of the technical provisions, it may be convenient to summarize them in the general provisions giving complete information as to title, serial number, and date of issuance or revision as in the following example.

*Standard Specifications.* Except where modified by this specification or its accompanying drawings, the standard specifications given in the following list shall govern in all cases where references thereto are made. Special care shall be exercised to refer to these specifications and to any modifications thereof in requests for quotations, purchase orders, and subcontracts.

#### STANDARD SPECIFICATIONS

No.	TITLE	DATE OR EDITION
.....	.....	.....
.....	.....	.....

**1.09. Data from Borings and Test Pits.** Give information as to where data from borings and test pits may be examined, and state that the contractor must draw his own conclusions therefrom as to the conditions to be encountered in the work. This clause should also state that the owner assumes no responsibility and gives no guarantee as to what conditions actually will be found to exist when the work is being carried out.

**1.10. Drawings Required of the Contractor.** In order to fabricate and erect the structure shown on the contract drawings, it is necessary for the contractor to prepare shop drawings, working drawings, rivet lists, match-marking diagrams, camber diagrams, and erection drawings for structural steel construction; bar schedules and bending details for reinforced concrete construction; and details for cofferdams, bracing, falsework, forms, and the like which show the methods the contractor proposes to use in the construction work. This clause of the specifications should require the contractor to submit all such drawings for examination and approval by the engineer



prior to the ordering of materials although the engineer's approval of shop drawings is not to relieve the contractor of any responsibility for furnishing materials of the proper dimensions and quality. The following example illustrates the requirements for drawings prepared by the contractor in heavy construction work.

*Drawings Required of the Contractor.* The contractor shall submit triplicate prints of drawings showing bar schedules and bending details of all steel reinforcement; complete drawings of cofferdams, bracing, falsework, and forms; and complete general drawings, shop drawings, erection diagrams, camber diagrams showing the position of the structure at various stages during the erection, match-marking diagrams, and rivet lists for structural steel and miscellaneous metal parts. Approval by the engineer of shop drawings shall not relieve the contractor from furnishing material of proper dimensions, quantity, and quality, nor will such approval relieve the contractor from responsibility for errors of any sort in the shop drawings or for the strength and sufficiency of cofferdams, bracing, falsework, forms, and other construction proposed or designed by him.

The estimated weight of each shipping unit shall be clearly marked on the shop drawings on which this unit is detailed.

The contractor shall bear all costs or damages which may result from the ordering of any materials prior to the approval of the shop drawings; and no work shall be done until the shop drawings therefor have been approved.

In case of correction or rejection, the contractor shall resubmit shop drawings until such time as they are acceptable to the engineer, and such procedure will not be considered as a cause for delay.

After approval of shop drawings, the contractor shall supply the owner with as many prints of the approved drawings as may be ordered.

**1.11. Sequence of Work.** When the plans of the owner, the character of the work or the public interests indicate the necessity for a definite sequence of operations or a particular schedule for the completion of the various parts of the work, specific details should be given. Otherwise the contractor should be allowed to exercise option in these matters subject to the approval of the engineer. The contractor should be required to prepare an approved progress schedule before the beginning of the work and to provide such equipment and carry on work simultaneously at as many points as will in the judgment of the engineer enable him to complete the work within the time specified in the contract. As soon as practicable after the first of each month the contractor should forward to the engineer a summary of the progress of the various parts of the work in the mills, shops, and field, giving the existing status, rate of progress, estimated time of completion, and causes of delay, if any.

**1.12. Control of Materials.** This clause should be a general requirement calling for the examination and testing of all materials of construction before acceptance, it being understood that the details of the various tests will be covered by the technical provisions. Samples are to be taken under the engineer's direction of all sand, gravel, stone, cement, concrete reinforcing bars, steel fabric, bituminous materials, structural steel, and other materials used in construction. The contractor is required to furnish all samples and bear all expense in connection with their sampling, transporta-

tion, and testing. Such samples are to be tested, and no material of which laboratory tests are required shall be used until accepted as the result of such test, and then only as long as the quality remains equal to that of the accepted sample. When large quantities of cement, structural steel, and the like are to be used provision should be made for mill inspection at the contractor's expense.

**1.13. Rates of Wages at the Site.** The Davis-Bacon Act requires that mechanics and laborers on U.S. Government contracts shall receive not less than the prevailing wage rates. These are predetermined for each contract by the Secretary of Labor and inserted in the general provisions of the specifications. Most states follow a similar procedure. For private work it is also advisable to make some stipulation as to wage rates in order to protect the owner against labor controversies and strikes. On smaller jobs it will be sufficient to require the contractor to pay wages not less than those prevailing in the locality. For more important work it may be desirable to form an agreement with representatives of the various trade unions as to specific wage rates for all trades and crafts and require these to be paid by the contractor under this heading in the specifications.

**1.14. Lines and Grades.** When construction surveys, lines, and grades are to be furnished by the engineer this clause in the general provisions should so state and require the contractor to give ample notice of the time and place where line and grade stakes are needed. Provision should be made for the contractor to suspend work when necessary to permit the carrying on of surveys, and he should be required to provide stakes and such ordinary labor as may be required by the engineer in this work without extra compensation.

When responsibility for the layout of the work is to be placed on the contractor, this clause should state that control points and elevations will be furnished by the owner and the contractor shall be responsible for all other surveys and measurements in connection with the work. The contractor at his own expense is to furnish all stakes, templates, platforms, equipment ranges, and labor required in laying out the work and is responsible for the proper execution of the work to the lines and grades shown on the drawings or indicated by the engineer.

**1.15. Space for Construction Purposes and Storage of Materials.** When limitations of space for construction operations and the delivery and storage of materials are expected, specific details should be given. The contractor should be required to furnish all necessary additional land required for the erection of temporary construction and storage facilities with right of access thereto at his own expense unless it is to the owner's best interests to furnish these facilities himself.

**1.16. Water, Power, Light, and Other Utility Services.** Information should be given as to the availability and location of the various required services and whether the expense for their use is to be the responsibility of the owner or the contractor.

**1.17. Facilities for the Engineer.** Under this heading the contractor is required to furnish at his own expense the facilities necessary for the engineer to carry on his work. Representative of such facilities are survey platforms, towers, etc., necessary for laying out and inspecting the work, and a field office for the engineer and his assistants furnished with drawing table, desk, chairs, light, heat, telephone, water and toilet, and the like. For work near water a power boat may be required. When important steel work is included two tested and certified steel tapes guaranteed to

agree with the shop standards of the manufacturer of the metal work should be furnished within one month after the signing of the contract.

**1.18. Warranties by Contract Bond.** List the mechanical and electrical equipment or other work to be furnished by the contractor to meet service or performance requirements which the contractor is to warrant to be free from defects of materials and workmanship for a specified period, usually one year, from the date of acceptance of the contract work. The contractor is required, upon notice, to make good at his own expense all defects developing during this period. These warranties may be covered by the contract bond, but they do not operate to defer final payment during the period specified, however.

**1.19. Special Precautions during Construction.** Under this and subsequent headings instructions should be given relative to any special requirements for the maintenance of traffic during construction, interference with navigation, protection of adjacent property, protection or relocation of public utilities, and the like.

**Outline of the Technical Provisions.** Whereas the general provisions of the specifications follow a similar form for all kinds of work the technical provisions are different for each type of structure. The job analysis will indicate the various section headings required in the outline. After the section headings are determined a careful summary of the subject matter should be made for each section in which the outline is broken down into paragraph and subparagraph headings. This can be done, of course, only after a thorough study and analysis of the detailed technical requirements for each type of construction. Students may gain much along this line by a study of specifications which have been used for actual projects. Here again, however, it is necessary to warn that there is no guarantee that a specification clause is sound and appropriate simply because it has been printed and used.

For some kinds of work, notably building construction, it is desirable to include an introductory paragraph to each section of the technical provisions defining in detail the scope of the work under each type of construction. This is for the convenience of contractors in obtaining bids from subcontractors who usually specialize in one trade or type of construction. The description of the work of each trade therefore serves to define the work to be included in each subcontract. It also results in economy when a large number of subcontracts is contemplated. The specifications can be taken apart and each subcontractor furnished with only the section covering the work to be performed by him. Otherwise a complete set of specifications would be required for each

subcontractor. For engineering construction work which usually employs a relatively small number of subcontractors there does not appear to be any advantage in this practice, and the writing of the specifications will be simplified by its omission. If a general description is required this should be placed in the first paragraph, followed in turn by the specifications for materials, workmanship, and location if the latter is not clearly evident on the drawings. For unit-price contracts the methods of measurement and payment should be covered in detail for each type of construction listed in the bid items.

The outlines which follow indicate the form of the technical provisions in the specifications for representative engineering and architectural construction projects. Section headings are given together with a brief discussion of the contents of each. In composition all subsections or paragraphs should be given titles and reference numbers as in the preceding outline for the general provisions. The comments and suggestions given are intended to represent current practice but the outlines should not be considered complete check lists.

## **HIGHWAY CONSTRUCTION**

### **1. GENERAL PROVISIONS**

### **2. CLEARING AND GRUBBING**

Specify the requirements in connection with the clearing of objectionable materials from the right of way, approaches, inlet and outlet ditches, and the grubbing of all stumps, large roots, buried logs, and other objectionable material below the ground's surface. The methods for removal and disposal of waste material and timber and the ownership of material cleared from the site should also be covered.

### **3. EARTHWORK**

Give the general instructions for excavating earth and rock from the roadway prism, ditches, channels, and borrow pits. Also include the instructions for constructing embankments at the proper elevations, backfill of ditches and depressions caused by the removal of obstructions, construction of approaches to new structures, and the like. Provide for the removal of all unsuitable materials and the backfilling of the resultant space with approved materials, and describe the methods for finishing slopes. Various classes of excavation should be accurately defined.

### **4. EXCAVATION FOR STRUCTURES**

Specify the instructions for excavation and backfill of trenches for pipe culverts, head walls, cut-off walls for slope paving, concrete culverts, re-

taining walls, and other appurtenant structures. Backfill specifications should include the thickness of backfill layers before compaction, sprinkling, tamping, rolling, and other compaction methods required.

#### 5. DITCH AND CHANNEL EXCAVATION

Include specifications for the excavation of all water channels above and below all culverts and bridges, and the use of the excavated material, when suitable, in road embankments and dikes.

#### 6. EMBANKMENTS

Embankment specifications should include the preparation of original ground by plowing or scarifying in order to allow new fill material to bond with the original earth. Specify the thickness of horizontal layers to be required in the placing of embankment fill and the methods for sprinkling and compaction by tamping or rolling. The contractor should be made responsible for maintaining the planned grades and cross sections of all embankments until the completion and acceptance of the work. He should also be made responsible for the stability of constructed embankments and should replace any portions which shrink or otherwise become displaced during construction.

#### 7. SURPLUS AND BORROW EXCAVATION

All surplus excavation should be used to widen embankments uniformly or to flatten slopes when desired. Provisions should be made for the disposal of all waste material not required for these purposes. When roadway excavation is not sufficient for the construction of embankments, provision should be made for local borrow from the excess widening of cuts or by excavating from sources within the right of way. The location and extent of local borrow should be placed under the control of the engineer. When imported borrow is necessary, state whether borrow areas are to be furnished by the owner or by the contractor, and the conditions under which they are to be used in lieu of roadway excavation.

#### 8. OVERHAUL

State the conditions, if any, under which the contractor will receive special payment for the overhauling of excavated material and the distance within which the cost of hauling is included in the unit price paid for excavation.

#### 9. SLOPE EROSION PROTECTION

Cover the placing of top soil, seeding, and other methods to be used to protect roadway slopes from erosion. Instruction should be included for the preparation of the slopes to receive the protection material and the methods to be used in placing, spreading, and planting.

#### 10. SUBGRADE

Specify the procedure for the finishing of the subgrade to true grade and cross section and the methods to be used in placing it in readiness to receive the roadway surfacing. The specific requirements for subgrade finishing will depend upon the type of pavement to be used.

## 11. PAVEMENT

Describe the type of pavement to be used, the quality of materials, the side forms, and the mixing and placing of the pavement. For reinforced concrete paving, specifications for reinforcement steel and dowels must be included. Give the details for construction joints, contraction and expansion joints, and the methods for finishing the pavement's surface. Also include the curing of the fresh pavement and its protection against damage during the curing period.

## 12. SHOULDERS

Provide for the placing of shoulders on both sides of the pavement or surfacing and the quality of materials to be used in their construction. Methods for placing, shaping, sprinkling, and compaction should be included.

## 13. FINISHING ROADWAY

Give the requirements for finishing the entire roadway after the earth-work has been completed and the surfacing or pavement has been placed. This includes the trimming of shoulders, slopes of embankments, excavation, road approaches, ditches, borrow pits, and the like and the removal of large loose rock from the finished roadbed.

## 14. BASIS OF MEASUREMENT AND PAYMENT

It will usually be desirable to include a description of the basis of measurement and payment for each of the bid items where each of these items is specified in the technical provisions rather than in a separate section. Payment is usually made on the contract unit price per cubic yard of excavation, and the specifications require that excavated material from the roadway be used for the construction of embankments. Borrow-pit excavation when required is likewise paid for on a cubic-yard basis except when it is elected optionally by the contractor in lieu of the placing of roadbed excavation. In the latter case, the roadbed excavation would otherwise be used on the job or disposed of at the expense of the contractor. No direct payment is made for embankment construction. Excavation may be classified as, for instance, earth, rock, and top soil with a separate unit price for each class, or it may be unclassified, in which case all materials are paid for at the same unit price.

# BRIDGE CONSTRUCTION

## 1. GENERAL PROVISIONS

## 2. EXCAVATION

Define the classes of excavation for which unit-price payments are to be made. Provide for the use of suitable excavated materials in the construction of approach embankments; for the removal of all objectionable materials, such as trees, stumps, boulders, or other obstructions; and for the disposal of all unsuitable materials elsewhere. When pier foundations

are to rest upon rock, the surface of the rock should be removed to expose sound material and the surfaces levelled off to provide horizontal or stepped bearing surfaces. Objectionable seams in the rock should be grouted under pressure. When piles are used and masonry is to rest on excavated surfaces other than rock, care should be taken not to disturb the original soil at the bottom of the excavation. All excavation should be completed to the bottom of the pier bases before any piles are driven. Any disturbances at the bottom of the excavation during the driving of piles shall be corrected. After the concrete is placed, excavation should be backfilled where necessary to the established grades, the filling material being thoroughly compacted and surfaced.

### 3. DEPTH OF PIER BASES

The elevations of the bottoms of piers and abutments shown on the plans are usually considered as approximate only, and it may be necessary to require the contractor to dig test pits or make test borings during the progress of excavation in order to determine the exact character of foundation material and the final depth to which piers are to be constructed.

### 4. OPEN COFFERDAMS

Where piers are to be constructed in open cofferdams, the specifications should state that the structural pier bases will be constructed in the dry. Before the pier bases are poured a concrete seal should be provided in the cofferdam by "tremie," or other underwater concrete placing methods. Details of materials and workmanship for concrete in pier bases and pier shafts will be specified under the heading "Concrete Work." Design of the cofferdams and the method of their construction should be the responsibility of the contractor subject to approval by the engineer of the design and methods of bracing and sealing. Allowable tolerances in location and alignment should be fully described. Also provide for the removal of cofferdams, sheeting, and bracing to the level of the stream bed after the completion of the substructure.

### 5. PNEUMATIC CAISSONS

The responsibility for the design and construction of pneumatic caissons should be placed upon the contractor, but complete working drawings should be furnished for examination and approval by the engineer before any construction work is started. Drainage wells, working shafts, air locks, and other facilities and equipment must usually conform to the requirements of state safety laws. Contractors should be required to furnish such facilities as hospital locks, lockers, and shower baths, as may be required for work under compressed air, when such facilities are not otherwise available. The method of sinking caissons should be optional with the contractor, and he should be permitted to predredge or to sink the caissons in so far as practicable by open dredging, provided that the final operation of preparing the rock bed, inspecting, and filling the working chambers is done under compressed air, reinforced concrete decks being placed in the dredging wells to permit the completion of the pier bases by the pneumatic process. Specifications should state the tolerances which will be allowed as to location, alignment, and level. Particular care should be taken in concreting the working chambers to obtain full bearing under

the entire cutting edge and under all bulkheads as well as against the roof of each chamber. Provision should also be made for the removal of the portion of the caisson above the stream bed after the completion of the work, if this is required.

## 6. PILING

When piers and abutments are to be founded upon piling, specifications should state the type of piles to be used, quality of materials, methods of driving, required bearing capacity, and methods by which the bearing capacity is to be determined. Provisions should be made for test piles when required, the removal of damaged and misdriven piles, and the tolerances which will be permitted with regard to location and alignment.

## 7. CONCRETE WORK

Define the classes of concrete work, and specify the quality of materials and workmanship required for each. Such features as standard specifications for cement, aggregate, water, and reinforcing steel and the requirements as to mixing, placing, vibrating, and curing concrete should likewise be covered. The requirements for the materials and workmanship in formwork should be given. When under-water tremie seals are contemplated in the open-cofferdam method of pier construction, detailed instruction should be included for the mixing and placing of tremie concrete. It may be desirable to devote a subparagraph to the particular requirements for formwork, mixing and placing concrete, and waterproofing for each of the types of work, as, for instance, tremie seals, pier bases, pier shafts, abutments, roadway deck, and the like. Anchor bolts, steel anchorages, sleeves, nuts, and other embedments must be set in concrete to the proper location and grade.

## 8. MASONRY

Where bridge piers and abutments are to be faced with sawn granite or other masonry materials, the specifications for this work should be given under this heading.

## 9. STRUCTURAL METAL WORK

See Example on page 246. Specifications for painting steel work may be included in this section, but it will usually be desirable to devote an entire section to the various classes of painting.

## 10. BRIDGE FLOORING

Where reinforced concrete flooring is used, specifications for this work may be included under the heading "Concrete Work." For other types of decking a separate section will be required. In addition to the specifications for materials and workmanship, this section should also cover such items as roadway curbs and curb openings, joints, ducts to be placed in the floor system, special wearing surfaces, and the like.

## 11. ELECTRICAL WORK

Under this heading give the specifications for metal conduits, fibre ducts, pull boxes, and splicing chamber frames and covers, lighting standards and brackets, traffic signals, marine and aviation lights, roadway lighting units,



electrical equipment, and wiring. Control equipment, such as switches, magnetic contactors, circuit breakers, and the like should also be included.

## 12. APPROACH EMBANKMENTS AND ROADWAY SURFACING

In general, the specifications for bridge approach embankments and roadway surfacing will follow those previously outlined for highway construction, and the extent to which they are detailed will depend on the magnitude and the importance of this element of the work.

## 13. RIPRAP AND REVETMENT

Under this heading give the specifications for any stone riprap, revetment work, or bank protection for the piers, abutments, and channel at the bridge site.

## 14. MISCELLANEOUS WORK

Under this heading give the specifications for miscellaneous items not otherwise classified, such as toll collection booths, traffic barriers, bronze tablets, and the like. For large toll bridges, the toll collection facilities, consisting of the toll plaza, collection booths, and administration building, will require separate sections in the specifications.

## 15. BASIS OF MEASUREMENT AND PAYMENT

Occasionally bridges are built under lump-sum and cost-plus contracts in which case no mention in the specifications is necessary relative to measurement and payment. More frequently, however, this type of work is constructed under unit-price contracts, and the basis of measurement and payment must be established in the specifications for each of the various bid items, as, for instance, excavation, concrete in the pier bases, concrete in the pier shafts, reinforcing steel, structural steel, etc. When pneumatic caissons are contemplated, a separate lump-sum bid item is sometimes set up for each; otherwise their cost would be included in other bid items.

# BUILDING CONSTRUCTION

## 1. GENERAL PROVISIONS

## 2. PREPARATION OF THE SITE

This section covers the demolition and disposal of existing structures and provides for the ownership or re-use of materials cleared from the site. It may also include the protection of all conduits, drains, sewers, services, shrubs, and lateral support of adjacent buildings.

## 3. EXCAVATION

Give directions for the excavation for foundations, basements, trenches, tunnels, elevator pits, and the like. Give particulars as to caissons, shoring, bracing, sheeting, underpinning and protection of adjacent buildings, cribbing, etc. Also specify the quality of materials, the methods to be used for backfilling and grading, the disposal of surplus excavated materials, and the storage of top soil or other materials to be replaced upon completion of the work.

#### 4. FOUNDATIONS

If pile foundations are to be used, give the type, quality, bearing capacity, and methods of driving. Specify the methods for determining pile bearing capacity, and give the details of any tests required. For pile caps, spread footings and foundation walls, and basement floors, cover the quality of materials and workmanship.

#### 5. CONCRETE WORK

Specifications for all concrete work on the job should be covered in this section. Describe the various classes of concrete, and give the details as to quality of materials, proportions, and workmanship for each. Construction of forms, mixing, placing, and curing of concrete should also be included. Under subheadings, detailed instructions should be given for the concrete work for the various elements of the structures, such as footings, foundation walls, floor slabs, framing elements, concrete fill, and the like. Mill and field tests should also be described. Reinforcing steel may be specified either in this section or under "Structural Steel Work."

#### 6. MASONRY

Specify the quality of materials, the proportions and the methods of mixing masonry mortars, and any tests required therewith. Also specify the quality of common brick, face brick, structural clay tile, concrete blocks, stone, glass blocks, architectural terra cotta, and other masonry materials. Standards of workmanship should be specified in detail. For small buildings, specifications for all types of masonry construction may be included in one section, but, for large important structures, a separate section may be required for each type.

#### 7. WATER-PROOFING AND DAMP-PROOFING

Schedule the materials and methods to be used for the water-proofing of elevator pits, pump sumps, basement walls, tunnels, floors, spandrels, and ceilings. Roof water-proofing and flashing would ordinarily be specified in a separate section. Integral water-proofing will usually be included with the concrete specifications, but all other types may be placed in this section. This includes the membrane types and their protective coatings, plaster and iron coats, and damp-proofing mixtures that are brush, spray, or trowel applied.

#### 8. STRUCTURAL STEEL AND IRON WORK

This section covers the specifications for the fabrication and erection of all structural steel and iron in the building frame, including the columns, beams, trusses, hangers, billet plates, stiffeners, anchor bolts, nuts, rivets, and connections. The quality of materials is usually made to conform with the Standard Specifications of the American Society for Testing Materials, and the fabrication erection standards are those recommended by the American Institute of Steel Construction, Inc. Miscellaneous items, such as lintels, elevator guides, steel door bucks, steel joists, and steel anchors for other trades, may be included in this section or specified separately under "Miscellaneous Metal Work." Ornamental metal work also is usually specified in a separate section.

## 9. MISCELLANEOUS METAL WORK

Under this heading are included the specifications for materials and workmanship for such miscellaneous items as gratings, coal chutes, package chutes, curb guards, trench covers, door bucks, lintels, flag poles, smoke stacks, steel stairs, and the like.

## 10. METAL DOORS, WINDOWS, AND TRIM

Fire-resistant metal doors and windows are generally furnished in standardized proprietary brands. The specifications therefore will indicate various approved models and manufacturers. Performance requirements may also be incorporated as well as the required quality of workmanship in fabrication and installation. Window screens may be specified under this heading, or they may be covered in a separate section.

## 11. CARPENTRY

For ordinary buildings this section will be subdivided in two parts: rough carpentry and finished carpentry. For larger projects each type may require a separate section in specifications. Rough carpentry includes framing, posts, bearing partitions, platforms, girders, basement steps, roof trusses, stud partitions, and the like. It also includes cornices, water tables, nailing strips, blocking, centering for masonry openings, timber door bucks, roof and wall sheathing, shingles, rough flooring, and the installation of building papers and insulation. Lumber specifications should describe the grades, species, and seasoning.

Finished carpentry includes moldings, ballustrades, doors and door frames, window frames, sash and trim, panelling, stair steps, cabinet work, and the like. Methods of nailing, joining, finishing, and other qualities of workmanship should be specified.

## 12. ROOFING AND SHEET-METAL WORK

Under this heading cover the quality of materials and workmanship for the roof surfacing, giving detailed instruction for construction at changes of roof slope, pipes and chimneys through the roof, dormers, roof vents and sky-lights. Some types of roof surfacing are proprietary and when these are desired, specifications should be based on guaranteed performances and approved types should be identified. Sheet-metal requirements, such as flashing at joints and openings, roof ventilators, louvers, ventilating ducts, radiator enclosures and gutter leaders and outlets should be specified as to the type, thickness, and quality of materials and workmanship. Methods for ribbing, seaming, and painting of sheet-metal roofing should be given.

## 13. FURRING, LATHING, AND PLASTERING

Type and quality of furring, lathing, metal beads, grounds, and parting strips should be described in the specifications when not shown on the drawings. For plastering the quality of the ingredients and the methods of mixing and placing the various coats should be specified. The desired wall finishes should be described, and, for special finishes, samples should be required in advance of the work.

## 14. GLASS AND GLAZING

State the type, thickness and quality of glass for windows, doors and mirrors, scheduling the types to be placed in steel sash, wood sash, transoms,

wood doors and metal doors respectively. Types of glass will include clear window glass, polished plate glass, figured and processed glass, wire glass, and corrugated, prism, and safety glass, among others. Composition of putty, lead, mastic or other materials for setting glass should also be given. Specify the details for bedding, back puttying and face puttying, and for securing glass in the sash. Make provisions for the cleaning and replacing of the broken panes before the completion of the work.

## 15. PAINTING AND FINISHING

This section should contain the specifications for both outside and inside painting. Outside work consists of exterior woodwork and trim, siding, metal work, roofs, cornices, and gutters. Interior work includes floors, walls, ceilings, trim, exposed radiators, pipes, and the like. The American Society for Testing Materials has prepared standard specifications for the quality of paints, varnishes, stains, and shellacs, and these may be used in combination with paint materials' specifications, based on the furnishing of proprietary products by approved manufacturers. For large projects it will be advisable to specify mixing formulas as well. Workmanship specifications should contain detailed instructions for the preparation of surfaces and the manner in which priming and finished coats are to be applied to all surfaces, such as wood, metal, plaster, and masonry materials. It is advisable to provide for the approval of samples before any paint materials are ordered, and detailed instruction should be included for the protection of painted surfaces and cleaning up after the completion of the work.

## 16. HARDWARE

Rough hardware includes stair rail brackets, shelf supports, drawer guides, door stops, sash weights, folding partitions, and the like whereas finishing hardware includes door butts, knob locks, metal sash, transoms, etc. Nails, spikes, bolts, anchors, screws, etc., should be required in connection with hardware work. Usually the hardware specifications will contain schedules of approved proprietary brands for each type of hardware. These schedules will also supplement the drawings by indicating the location of hardware installations in the various parts of the building. It is advisable to require all hardware to be installed in accordance with the manufacturer's directions and to require approval of samples before ordering.

## 17. PLUMBING

Give the instructions for the installation of storm water and floor waste drainage systems, sanitary drainage system, hot and cold water systems, automatic sprinkling systems, gas piping and plumbing fixtures. Specify the type, size, weight, and quality of cast iron, wrought iron, brass, galvanized, and lead pipe, fittings, and sleeves. Pipe installation and painting should also be included. Such fixtures as water closets, bath tubs, sinks, laundry tubs, lavatories, and the like will usually be selected from the available standard brands, and the specifications should state the model, color, size, style of trimming and should list approved manufacturers for each fixture. Tabular schedules are very convenient for this purpose. It is usually advisable to require a warranty from the contractor that the plumbing installation will be free from defects of materials and workmanship for a stipulated period of years and he should be required to replace all defective work within that period at his own expense. "Roughing-

in" work for plumbing installations requires close coordination with other types of construction and other trades, and the specifications should be explicit in this regard.

## 18. HEATING AND VENTILATING

Specify the installation of furnaces, boilers, registers, radiators and piping, ducts, stacks, louvers, control equipment, and other appurtenances. Ventilation equipment includes fans, motors, and ducts. Air-conditioning equipment should be installed in accordance with the manufacturer's instructions. All heating, ventilating, and air-conditioning installations should be warranted by the contractor to be free from defects of materials and workmanship.

## 19. ELECTRICAL WORK

This section covers the complete electric light and power system, including telephone, burglar alarm, fire alarm, and radio reception systems. All work should be in accord with the National Electrical Code and the local utility regulations. Specify the type and quality of wires and cables, conduits, outlet boxes, switches, outlet receptacles, and fixtures. Where not shown on the drawings, the location of all outlets and switch boxes should be described in the specifications. A warranty from the contractor should be required in connection with the installation of all electrical work.

## 20. ELEVATORS AND DUMB-WAITERS

Schedule the number of cars and locations for passenger, freight, and service elevators and dumb-waiters. Hatchway construction will be included with the structural specifications, but extraordinary precautions must be taken to make certain that the requirements as to dimensions and vertical alignment are properly specified. The materials, finish, and equipment for cars must be covered, likewise accessories and appurtenances, such as guides, hatchway entrances, signals, controls, and buffers. Provide for load, levelling, and speed tests and tests of the control and signal systems. Elevator specifications will usually be based on performance, and warranties should be required.

## 21. INSULATION

Under this section specify the requirements for heat insulation, such as mineral wool, felt, and reflective sheet metal. Acoustical insulation, such as acoustic tiles, plaster, and felts, may also be included in this section. Specifications for insulation materials will usually be based on performance, and they should be installed in accordance with the manufacturer's instructions. The specifications should contain a list of approved standard products.

## 22. SEWERS AND SEWAGE DISPOSAL

When outside sewers and sewage-disposal equipment, such as septic tanks, sludge pits, sand filters, and the like, are included in the building contract, specifications should contain instructions as to materials and workmanship.

## 23. LANDSCAPING

Specify the requirements as to finished grading, seeding, and planting after the completion of the building structure.

## 24. MISCELLANEOUS WORK

Specifications for minor items not otherwise classified may be grouped under this heading. Typical of these are driveways, sidewalks, curb and gutter, fences, gates, and the like. Individual items of this character are usually small in scope, but for larger projects some may justify individual sections in which specification requirements are treated in more detail than would be necessary for ordinary work.

## 25. BASIS OF MEASUREMENT AND PAYMENT

Practically all building construction in the United States is accomplished under lump-sum or cost-plus contracts, and no mention of measurement and payment is necessary in the specifications. Sometimes, however, it is desirable to handle some parts of the building, such as foundation work, on a unit-price basis, with the remainder of the structure paid for as a lump sum. When this is done the specifications must be explicit as to the bid units and methods of measurement and payment for the unit-price work.

# EARTH DAM

## 1. GENERAL PROVISIONS

## 2. DIVERSION AND CARE OF WATER DURING CONSTRUCTION

Define the various classes of excavation for the diversion channel, and give instructions for backfilling after completion of the work. Specifications for the construction of the cofferdam or other diversion works and the maintenance of stream flow during construction should also be included.

## 3. CLEARING AND GRUBBING

Describe the areas to be cleared, the requirements as to the removal of all surface material and the grubbing of stumps, roots, buried logs, and the like below the ground surface, the disposal of waste material, and the ownership of timber and other materials cleared from the site.

## 4. DRAINAGE OF EARTH-EMBANKMENT DAM STRUCTURE

Classify the materials to be excavated for foundation drains, and give instructions for trench sheeting and slope protection to prevent slides. Specify the quality of materials and construction details for the various types of drainage pipe, and give the methods for placing backfill of both pervious and impervious types.

## 5. EXCAVATION AND EMBANKMENT

Cover the stripping of vegetation and top soil, the classification of excavated material, shoring, blasting, hauling, testing, and the like. Give the limits of excavation of such structures as the spillway, core trench, embankment, and tailwater channel. Specifications for embankments should include instructions for the preparation of foundations, control of spring areas, selection of materials for the various zones of the core and embankment, methods of placing selected impervious and pervious materials, moisture control, compaction, soil tests, and the like. Also include speci-

fications for the placing of top soil on completed embankments, seeding, planting, and landscaping.

#### 6. FOUNDATION DRILLING AND GROUTING

Cover the drilling and grouting procedure, records of drilled material, types of holes, grout outlets, and drainage. Also included are grouting pipe, fittings and valves, and the methods to be used in pressure grouting.

#### 7. REVETMENT AND GRAVEL BACKING

Specify the quality and sources of material to be used for revetment and backing of slopes and channels and the instructions for placing truck-dumped and derrick-placed types of revetment.

#### 8. CONCRETE CONSTRUCTION

Cover the quality of concrete ingredients, proportioning, mixing, placing and finishing of concrete mixtures, including classification of the different mixes to be used on the job. Also specify the use of admixtures and special mixes, construction joints, forms, expansion and contraction joints, embedded items and inserts, steel reinforcement, and testing.

#### 9. STRUCTURAL METAL WORK

Specify the quality of materials and workmanship for such items as structural steel work, reinforcement bars, steel plates, forged steel, cast steel, cast iron, bronze castings, trash racks, penstocks, bulkheads, hand rail, pipe, pipe fittings, and valves. Give special attention to tolerances, finish, adjustments, and the like. For a small project the specifications for metal work, piping, and painting may be combined in one section. For larger projects they should be separated with a full section devoted to each.

#### 10. GATE HOUSE

Specifications for the gate house will follow the general procedure indicated for building construction. For small projects the entire structure could be handled in one section, but for more complex installations the specifications should be subdivided with each type of construction covered in detail.

#### 11. MACHINERY

Under this heading give the specifications for the cranes, movable gates, hoisting machinery, gate position indicators, and control equipment. These specifications will normally be based on performance and acceptance tests, and warranties should be required.

#### 12. ELECTRICAL WORK

Give the details of the materials and workmanship for conduits, boxes, conductors, grounding system, receptacles and plugs, switches, lighting fixtures, flood lights, panel boards, motors, transformers, automatic recording gauges, and the like.

#### 13. MISCELLANEOUS WORK

Specifications for minor miscellaneous items not otherwise classified, such as small water-supply systems, stand-by power units, gauge-recording houses, and the like may be grouped under this heading.

## 14. BASIS OF MEASUREMENT AND PAYMENT

Practically all contracts for earth-dam construction are on a unit-price basis. Methods of measurement and payment must be specified for each of the bid items, either in a separate section at the end of the specifications or in a separate paragraph in each of the sections containing the technical provisions for the various types of construction.

## WATER DISTRIBUTION SYSTEM

### 1. GENERAL PROVISIONS

### 2. EXCAVATION, TRENCHING, AND BACKFILLING

Define the various classes of excavation. Give directions for the disposition of waste materials. Give the widths and depths of trenches for various pipe sizes in different kinds of material. Specify the different types of material and the methods of placing to be used in backfill. State restrictions as to blasting of rock material.

### 3. PIPE LINES

Specify material which should be used in manufacturing pipe and the standards to which it should conform, together with the tests to be used. State the manner in which the pipe should be laid, giving the minimum cover, method of support, condition of trench, weather conditions which are unsuitable for such work, protection of pipe, and testing of pipe after sections of the line are completed. Also state methods of handling and storing pipe and precautions to be observed to prevent damage to special coatings. Give directions for cutting pipe. State maximum tolerances for deflections from alignment or grade and bracing required to prevent such deflections when the pipe line is under pressure. Give precautions to be taken to protect pipes from the entrance of dirt or water from the trench.

### 4. SPECIALS AND FITTINGS

Specify type and class of fittings, standards to which they should conform, and tests to which they should be subjected. Give directions for cutting threads, arrangements of fittings, methods for connecting with mains, and precautions to be taken in handling.

### 5. JOINTS

State the type of joint compound to be used, the standards to which they shall conform, and the ingredients of patented compounds which may be used. The method of making the joint should be described in detail including the manner in which the jointing material should be prepared for use and the precautions to be taken to prevent the use of jointing material which has become dirty, cold, or otherwise undesirable. If gaskets for flanged connections are required, material of which they may be composed should be specified, and detailed dimensions should be given. Specifications for bolts should indicate the type of heads, the standards to which they should conform, and whether they shall be corrosion resistant, bituminous coated, etc. Where applicable, the method of tightening bolts and making screwed connections should be specified.



## 6. VALVES AND VALVE BOXES

The type of valves should be specified together with details of their design, the standards to which they should conform, and the tests to which they should be submitted. Directions for placing the valves in the lines, methods of bracing and backfill, and the use of bridle rods where required should be stated. The type of material, dimensions, design, and instructions for the installation of valve boxes should be specified.

## 7. HYDRANTS

The type of hydrants, the pressure for which they shall be suitable, and the standards to which they shall comply should be shown. Details of the design should be indicated, giving minimum allowances for valve openings, friction losses, and the number and size of hose connections. The kind of material and type of thread for the hose nipples should be stated. The manner in which the hydrants are to be placed in the trench, their foundation, method of drainage, bracing, and ties with the pipe line should be specified. The manner in which the hydrants should be painted should be shown, giving the type of paint and number of coats. Operating test for hydrants should also be specified.

## 8. SERVICE CONNECTIONS

Type of corporation stops, couplings, and joints between the mains and the house laterals should be specified. The method of making connections in the mains should be described, and the tests to which the house connections must be subjected should be stated.

## 9. HYDROSTATIC FIELD TESTS

The pressure to be used in the tests should be stated, giving the length of the section to be tested and the manner of blocking off sections of the pipe. The manner of making the tests, the determination of leakage, and the manner of correcting the leaks should be described.

## 10. STERILIZATION OF COMPLETED LINE

Specify the agent to be used for sterilization, the method of application, the results desired, and the test for the effectiveness of the process.

## 11. MISCELLANEOUS WORK

Specifications for minor miscellaneous items not otherwise classified may be grouped under this head.

## 12. BASIS OF MEASUREMENT AND PAYMENT

Unit-price payments cover all service, labor, equipment, material and supplies specified and indicated for the work complete and ready for use. Incidental work including shop drawings, paint, couplings, joint material, testing and sterilization necessary in connection with each item is generally included with these items. Payment for excavation for pipe trenches is based on the theoretical yardage to be removed from the trench having the dimensions specified, and any over-cutting is the responsibility of the contractor or separate prices are given per linear foot of water pipe for various depths of trench and pipe sizes. Payment for the pipe is based

on the length of the pipe as laid, exclusive of the fittings. Fittings are usually paid for on a tonnage basis computed from manufacturer's figures. Valves, hydrants, and service connections are generally paid for on the basis of a lump sum for each.

## SEWAGE COLLECTION SYSTEM

### 1. GENERAL PROVISIONS

### 2. EXCAVATION, TRENCHING, AND BACKFILLING

Define the various classes of excavation. Give directions for the disposition of waste materials. Give the widths and depths of trenches for various pipe sizes in different kinds of material. Specify the different types of material and the methods to be used in backfill. State restrictions as to blasting of rock. Give instructions for dewatering, sheathing, and shoring trenches, and describe the manner in which sheathing or shoring should be removed.

### 3. PIPE LINES

Specify types of pipe which should be used and the standards of materials and manufacture to which each shall conform, together with the tests to which it should be submitted. State the manner in which the pipe should be laid; specify condition of the trench, holes for bells, method of support for the barrel of the pipe, exclusion of water and dirt from the pipe during laying, protection of the pipe, and testing of the pipe after sections of the line are completed. State methods of handling and storing pipe and precautions to be observed to prevent damage to special coatings.

### 4. SPECIALS AND FITTINGS

Specify type and class of fittings, standards to which they should conform, and tests to which they should be submitted. Give directions for cutting pipe, arrangements of fittings, and precautions to be taken in the handling and laying.

### 5. JOINTS

State the characteristics of the joint materials to be used, the standards to which each shall conform, and the ingredients of patented compounds which may be used. The method of making joints should be given in detail including the manner in which the jointing material should be prepared for use. Gasket material, couplings, and other incidental items where applicable must be specified. Where cement mortar joints are to be used, specifications should be given for the cement, lime, sand, and water and the method of mixing and application to the joints.

### 6. MANHOLES AND CATCH BASINS

Describe the types of manholes and catch basins required and the quality of materials and workmanship to be used in their construction. The manner of making excavation, mixing concrete, laying bricks, etc., should be covered in detail. Specify the results to be attained in regard to grade, alignment, and infiltration.

## 7. MANHOLE CASTINGS

Cast iron castings for manhole frames, covers, gratings, and ladder rungs should be specified as to quality of materials, and instructions should be given for their installation. Details of design and dimensions are usually shown on the plans.

## 8. MISCELLANEOUS WORK

Specifications for miscellaneous minor items not otherwise classified may be grouped under this heading.

## 9. FIELD TESTS

Describe the tests to be made for alignment, grade, and watertightness.

## 10. MEASUREMENT AND PAYMENT

Unit-price payments cover all service, labor, equipment, material, and supplies specified and indicated for the work complete and ready for use. Incidental work including jointing material, cutting pipe, and testing necessary in connection with each item is generally included with these items. Payment for excavation for pipe trenches is based on the theoretical yardage to be removed from a trench having the dimensions specified or separate prices are given per linear foot of sewer for different depths of trench and for the various pipe sizes. Payment for the pipe is based on the length of the pipe as laid including the fittings. This price also includes the cost of dewatering the trench and sheathing left in place. Fittings are paid for on a unit-price basis. Manholes are paid for in accordance with their depth on the basis of a lump sum for each.

# HARBOR DREDGING

## 1. GENERAL PROVISIONS

## 2. CHARACTER OF MATERIAL TO BE DREDGED

Generally the contractor is required to assume the responsibility of informing himself as to the nature of the material to be dredged, but such information as is available should be written into the specifications with a careful definition of the various classes of material to be removed.

## 3. DISPOSAL OF EXCAVATED MATERIAL

The specifications should require the contractor to comply with all laws and regulations and to furnish all permits required in connection with the handling of his equipment and the disposal of dredged material. Usually the drawings will indicate the location of suitable spoil areas, but the specifications should contain instructions requiring spoil to be evenly distributed so as to prevent the formation of shoals or obstructions to navigation. When the spoil is to be used to fill low areas, instructions should be given relative to the construction of retaining dikes, regulation of the dredge discharge to prevent the formation of mounds and depressions, and the drainage of the completed fill.

#### 4. BLASTING

Give instructions on the conduct of blasting for rock excavation including the types of blasting caps, the maximum amount of explosives to be used in each charge, and precautions to prevent damage to vessels and adjacent structures.

#### 5. SIDE SLOPES

Dredging plans usually indicate the side slopes of the excavation, but frequently these must be considered approximate. Therefore, provision should sometimes be made in the specifications for the final determination of side slopes during the progress of the work. Final determination of side slopes may be made from soil tests or by observation of natural slopes.

#### 6. OVERDEPTH

Because of inaccuracies in dredging processes, it is customary to allow the contractor some latitude with reference to grades in the removal of dredged material. Therefore, the specifications should state that in the event of accidental overdredging beyond the theoretical lines the contractor will be paid for excess material removed within prescribed limits. For earth, sand, or silt dredging, a maximum overdepth of 2 feet will usually be considered in computing dredged quantities. For rock dredging a maximum allowable overdepth of 3 feet is common. Overdepth allowances apply to side slopes as well as to channel bottoms.

#### 7. BASIS OF MEASUREMENT AND PAYMENT

Occasionally harbor dredging is accomplished under lump-sum contracts, but the majority of such work is done on a unit-price basis. This requires a description of the methods of measurement for the various classes of excavation. If measurement of quantities in their undisturbed condition is intended, provision must be made for soundings before beginning the work and for final soundings after its completion in order to compute the dredged quantities. If barge or other methods of bulk measurement are to be permitted, bulking factors must be specified for each class of excavation. The conditions, if any, under which the contractor will be paid stand-by rental for idle plant should be carefully defined when interruptions of the work are expected to permit the movement of ships.

### TIMBER DOCK

#### 1. GENERAL PROVISIONS

#### 2. DEMOLITION

Describe existing structures and old piles to be removed, and furnish information on the disposal or re-use of materials cleared from the site.

#### 3. PILES AND PILE DRIVING

State the type of piles to be used, quality of materials, methods of driving, required bearing capacity, and methods by which the bearing capacity is to be determined. Give detailed instructions on the removal of dam-

aged and misdriven piles and tolerances which will be permitted with regard to location and alignment of piles. Methods for splicing and lagging piles should also be included. Provision should be made for test piles when required.

#### 4. LUMBER

Specify the grade and quality of lumber to be used for the various elements of the structural framing, such as pile caps, stringers, bracing, and decking. All framing should be smooth and accurate, and all bearings should have full contact over the entire bearing surfaces.

#### 5. TIMBER PRESERVATIVE

Specify the type and quality of treatment to be used for the protection of all timber work and the methods for its application. Give details of special treatment required at tenons and heads of bolts, faces of caps and stringers, notches, and holes. Also give the precautions to be followed in handling the treated timber.

#### 6. FASTENINGS

Specify the quality of materials and workmanship for bolts, washers, nuts, straps, pile bands, clamps, spikes, and the like. When details of fastenings or connections are not shown on the drawings, they may be scheduled in this section.

#### 7. FITTINGS

Under this heading give the specifications for cast steel bits, cleats, and bollards. They should be set in cement mortar to secure uniform bearing, and the recesses at bolt nuts should be filled with lead and caulked. Hollow bits should be filled with concrete. Design details for fittings will usually be shown on the drawings, but the specifications should cover the quality of materials and workmanship.

#### 8. TRACK WORK

Under this heading the track rails, bed plates, splicing bars and bolts, cross-overs, and frogs and switches, together with their accessories and control equipment, should be covered in detail. Rails on curves should be bent accurately to the required radius, and the methods of installation should be described.

#### 9. PIPING

Under this heading specify the requirements for piping for the various services to be installed on the dock, such as salt water, fresh water, compressed air, fuel oil, and gas. Specifications should cover the quality of materials and workmanship for the various kinds of pipe to be used, including wrapping, painting and insulation, joint material and the method of making joints, valves, hydrants, outlet sleeves, supports, and manhole frames and covers.

#### 10. ELECTRICAL WORK

Specifications in this section contain the instructions for the installation of electrical conduits and ducts, telephone pull boxes and receptacles, wires and cables, lighting, and convenience outlets.

## 11. EQUIPMENT AND MACHINERY

This section covers such items of equipment as locomotive cranes, gantry cranes, derricks, and other accessories. These specifications will usually be based on performance and acceptance tests, and warranties should be specified.

## 12. BASIS OF MEASUREMENT AND PAYMENT

Both lump-sum and unit-price types of contracts are used for dock construction, and methods of measurement and payment must be specified for the unit-price form. For piling there will usually be a unit price per linear foot of pile with a different price for various increments of total length. It is advisable to provide for additions to and deductions from the total number of piles indicated on the drawings in the event that changes become necessary during the progress of the pile driving. Bracing, pile caps, stringers, decking, and other timber work will usually be paid for on the basis of a unit price per thousand feet board measure in place, with a separate unit price for each classification of timber work. Metal fittings, track work, and piping are usually paid for on a pound basis. A lump sum is frequently set up for the electrical work complete. Likewise, each principal item of equipment is usually paid for on a lump-sum basis.

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